US005315400A

United States Patent [19]

Kurata et al.

[11] Patent Number: 5,315,400

[45] Date of Patent: May 24, 1994

[54] **METHOD OF RECORDING AND REPRODUCING PICTURE INFORMATION, RECORDING MEDIUM, AND RECORDING MEDIUM PLAYING APPARATUS**

[75] Inventors: **Junichi Kurata; Satoru Nomura**, both of Yamanashi, Japan

[73] Assignees: **Pioneer Electronic Corp.; Pioneer Video Corp.**, both of Japan

[21] Appl. No.: **65,036**

[22] Filed: **May 24, 1993**

Related U.S. Application Data

[63] Continuation of Ser. No. 860,250, Mar. 27, 1992, abandoned, which is a continuation of Ser. No. 247,351, Sep. 21, 1988, abandoned.

[30] **Foreign Application Priority Data**

Mar. 11, 1988 [JP] Japan 63-57401

[51] **Int. Cl.**[5] **H04N 5/76**

[52] **U.S. Cl.** **358/335**; 358/342; 369/48; 369/54; 369/58; 369/124; 369/275.3

[58] **Field of Search** 360/14.1-14.3, 360/32, 33.1, 40, 48; 369/32, 44.28, 48, 49, 50, 54, 58, 124, 275.3; 358/335, 342, 183, 185, 903; 371/69.1; 340/723

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,697,176	9/1987	Kawakami	340/723
4,709,277	11/1987	Ninomiya et al.	360/14.3
4,729,043	3/1988	Worth	358/342
4,777,539	10/1988	Nomura et al.	358/342
4,852,105	7/1989	Kurz	371/69.1
4,860,272	8/1989	Nishikawa et al.	369/44.28 X
4,885,644	12/1989	Ishii et al.	369/58 X
4,899,233	2/1990	Yoshida	360/77.14
4,914,527	4/1990	Asai et al.	360/10.3
4,942,551	7/1990	Klappert et al.	360/48 X

FOREIGN PATENT DOCUMENTS

0308148 3/1989 European Pat. Off. .

OTHER PUBLICATIONS

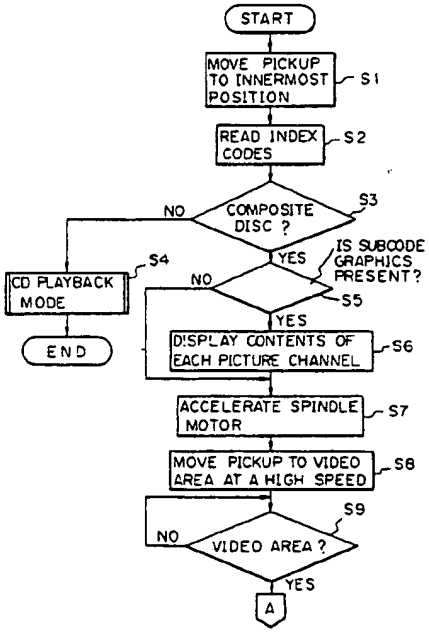
"Audio", Mar. 1987, pp. 26, 28, 30.
"Electronics" Mar. 19, 1987, p. 53.
"Electronik" 1980, No. 21, pp. 107-114.

Primary Examiner—W. R. Young
Attorney, Agent, or Firm—Wegner, Cantor, Mueller & Player

[57] **ABSTRACT**

A method of recording and reproducing picture information, a recording medium on which the picture information is recorded, and an apparatus for playing such a recording medium are disclosed. A video format signal and a coded information signal are recorded in a first area of the recording medium. Graphic codes including picture information occupying at least one channel in a channel group of N (N being a natural number equal to or greater than 2) channels are inserted as a subcode in the coded information signal. Identification code information of at least one channel is recorded in a second area of the recording medium. When the recording medium is played, the identification code information is displayed and a picture signal corresponding to the graphic code occupying a channel designated by a picture channel command for designating one channel in the channel group is mixed with the video format signal.

10 Claims, 22 Drawing Sheets



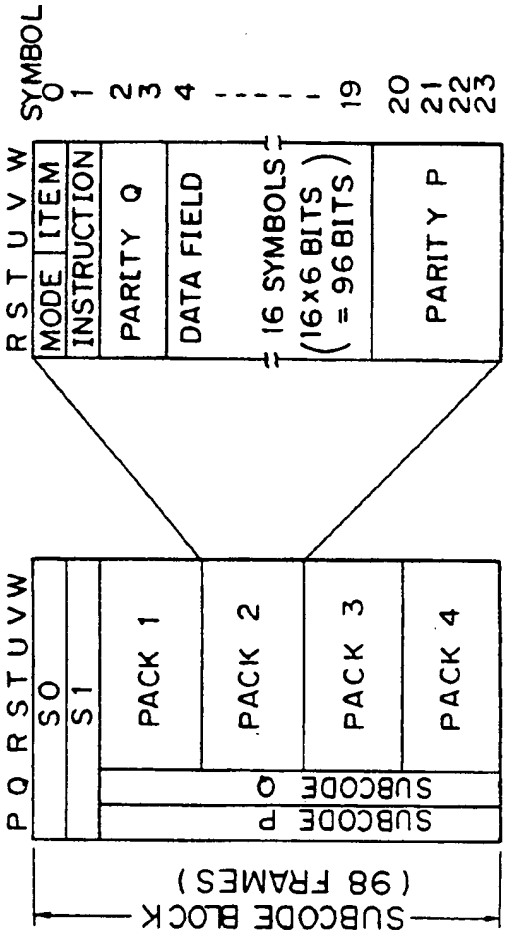

SYMBOL
0 1 2 3 4 ----- 19 20 21 22 23
R S T U V W
MODE
ITEM
INSTRUCTION
PARITY Q
DATA FIELD
16 SYMBOLS (16x6 BITS = 96 BITS)
PARITY P
P Q R S T U V W
S0
S1
PACK 1
PACK 2
PACK 3
PACK 4
SUBCODE Q
SUBCODE P
SUBCODE BLOCK (98 FRAMES)

Fig. 1

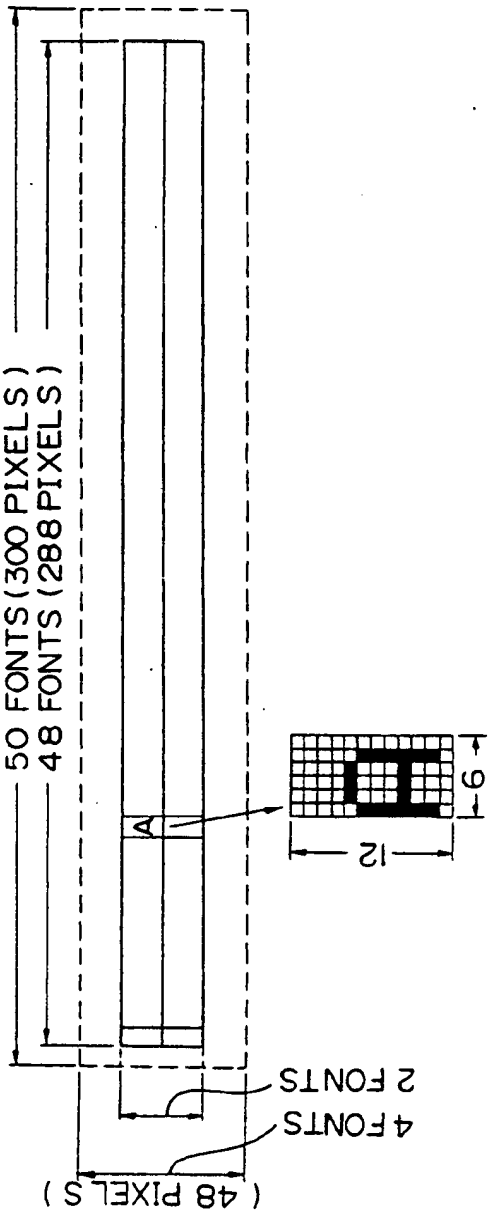

50 FONTS (300 PIXELS)
48 FONTS (288 PIXELS)
A
12
9
2 FONTS
4 FONTS
(48 PIXELS)

Fig. 2

Fig. 3

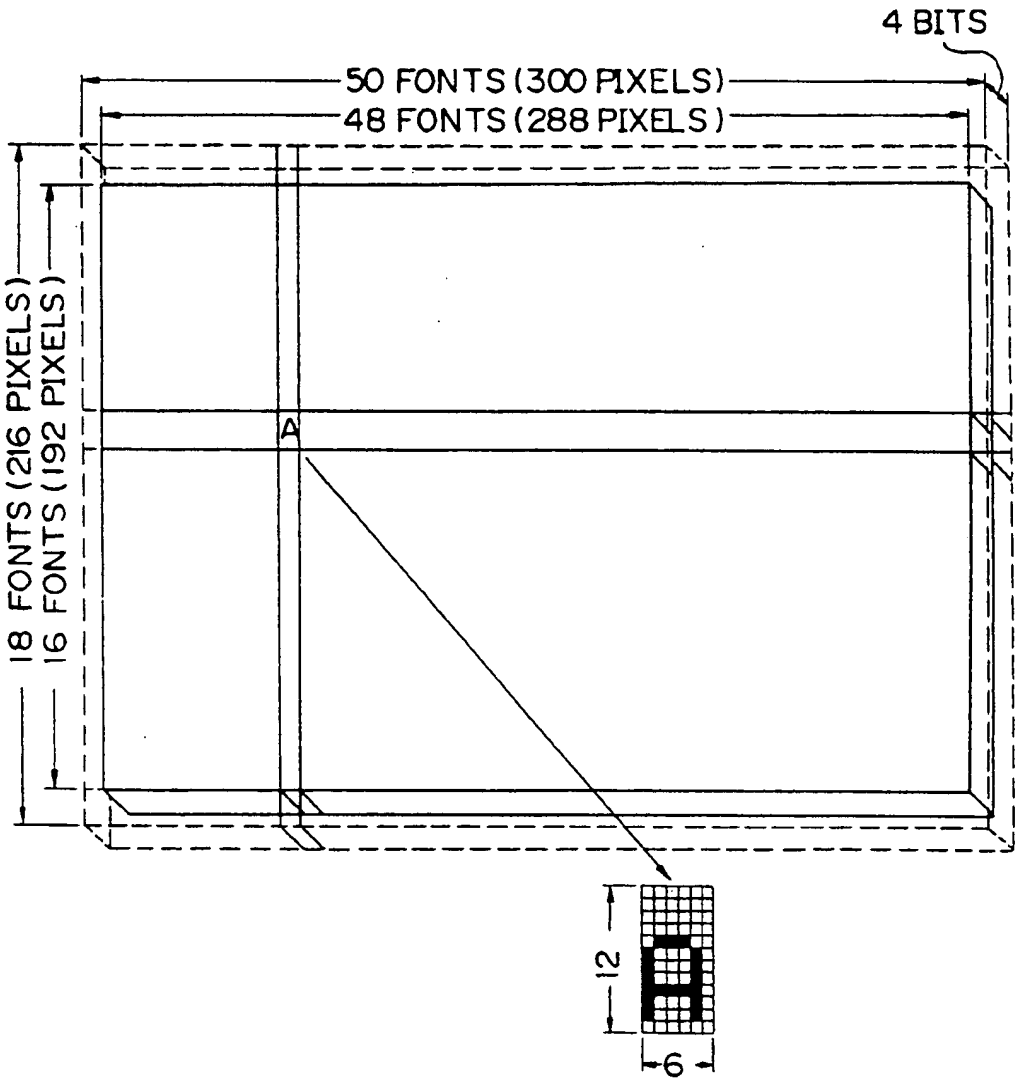

4 BITS
50 FONTS (300 PIXELS)
48 FONTS (288 PIXELS)
18 FONTS (216 PIXELS)
16 FONTS (192 PIXELS)
A
12
6

Fig. 4

MODE	ITEM	
0 0 0	0 0 0	ZERO MODE
0 0 1	0 0 0	LINE-GRAPHICS MODE
0 0 1	0 0 1	TV-GRAPHICS MODE
0 0 1	0 1 1	GRAPHICS MODE WITH MOTION PICTURE
1 1 1	0 0 0	USER'S MODE

Fig. 5

SYMBOL		R S T	U V W
	0	0 0 1	0 1 1
	1	0 1 1	1 0 0
	2	PARITY Q	
	3		
	4	TCB-0	TCB-1 TCB-2
	5	TCB-3	TCB-4 TCB-5
	6	TCB-6	TCB-7 TCB-8
	7	TCB-9	TCB-10 TCB-11
	8	TCB-12	TCB-13 TCB-14
	9	TCB-15	0 0 0 0
	10	0 0	0 0 0 0
	⋮		
	19	0 0	0 0 0 0
	20	PARITY P	
	⋮		
	23		

Fig. 6

TCB	MODE	SUBCODE PICTURE	MOTION PICTURE
0 0	TRANSPARENT MODE	0 %	100 %
1 0	MIXING MODE	M %	(100-M) %
1 1	NON-TRANSPARENT MODE	100 %	0 %

Fig. 7

SYMBOL	R	S	T	U	V	W
0	0	0	1	0	0	1
1	0	1	1	1	1	0
2 3	PARITY Q					
4 5	COLOR 0					
6 ⋮ 17	⋮					
18 19	COLOR 7					
20 ⋮ 23	PARITY P					

Fig. 8

SYMBOL	R	S	T	U	V	W
0	0	0	1	0	0	1
1	0	0	0	1	1	0
2 3	PARITY Q					
4	CHANNEL	COLOR 0				
5	CHANNEL	COLOR 1				
6	0	ROW				
7	COLUMN					
8 ⋮ 19	FONT					
20 ⋮ 23	PARITY P					

Fig. 9

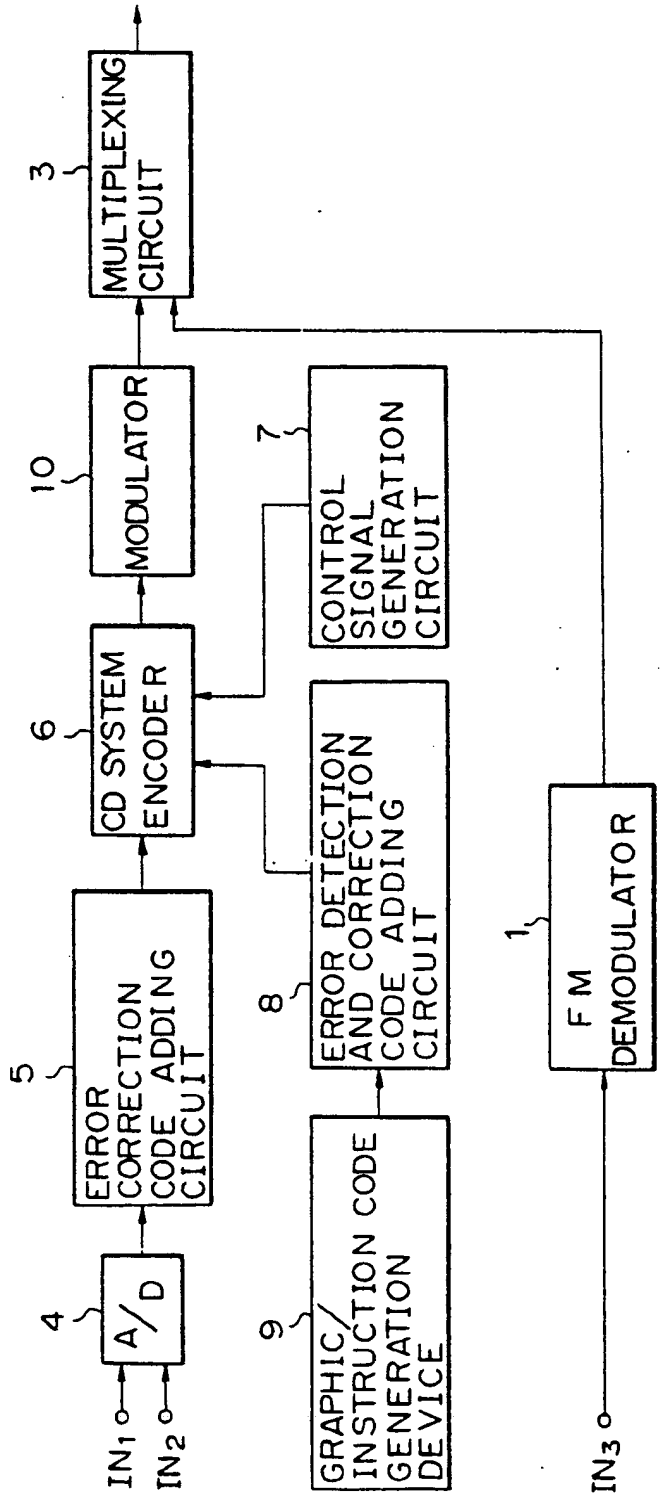

MULTIPLEXING CIRCUIT
3
MODULATOR
10
CD SYSTEM ENCODER
6
CONTROL SIGNAL GENERATION CIRCUIT
7
ERROR CORRECTION CODE ADDING CIRCUIT
5
ERROR DETECTION AND CORRECTION CODE ADDING CIRCUIT
8
F M DEMODULATOR
1
A/D
4
GRAPHIC/ INSTRUCTION CODE GENERATION DEVICE
9
IN1
IN2
IN3

Fig. 10

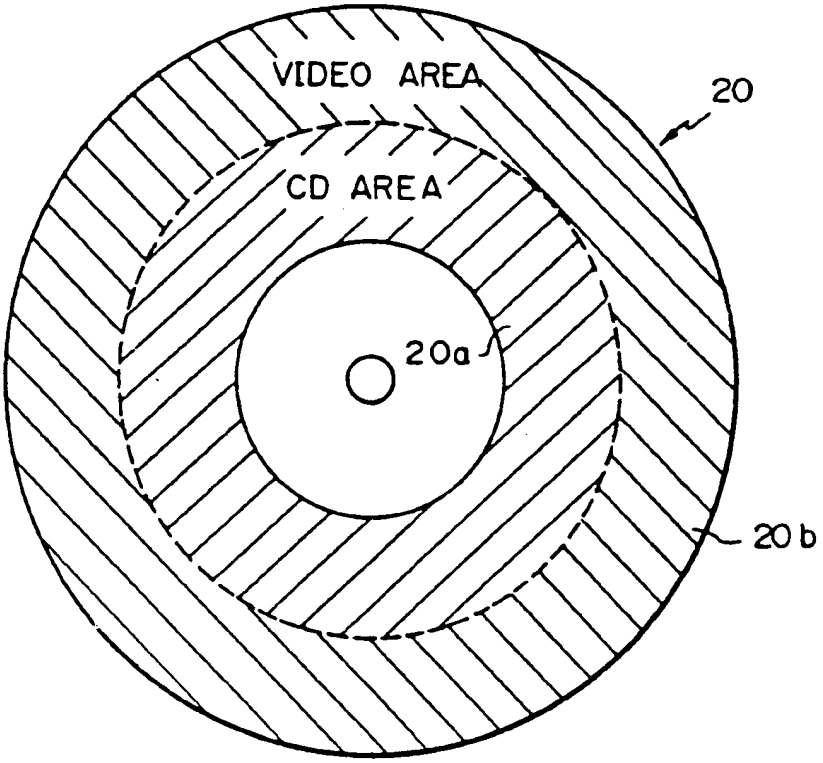

VIDEO AREA
20
CD AREA
20a
20b

Fig. 11

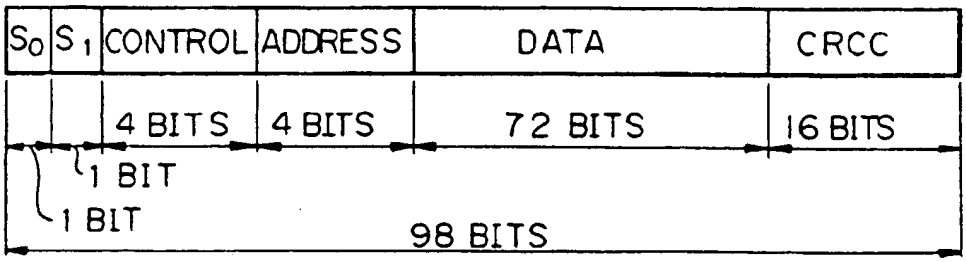

S0
S1
CONTROL
ADDRESS
DATA
CRCC
4 BITS
4 BITS
72 BITS
16 BITS
1 BIT
1 BIT
98 BITS

Fig. 12

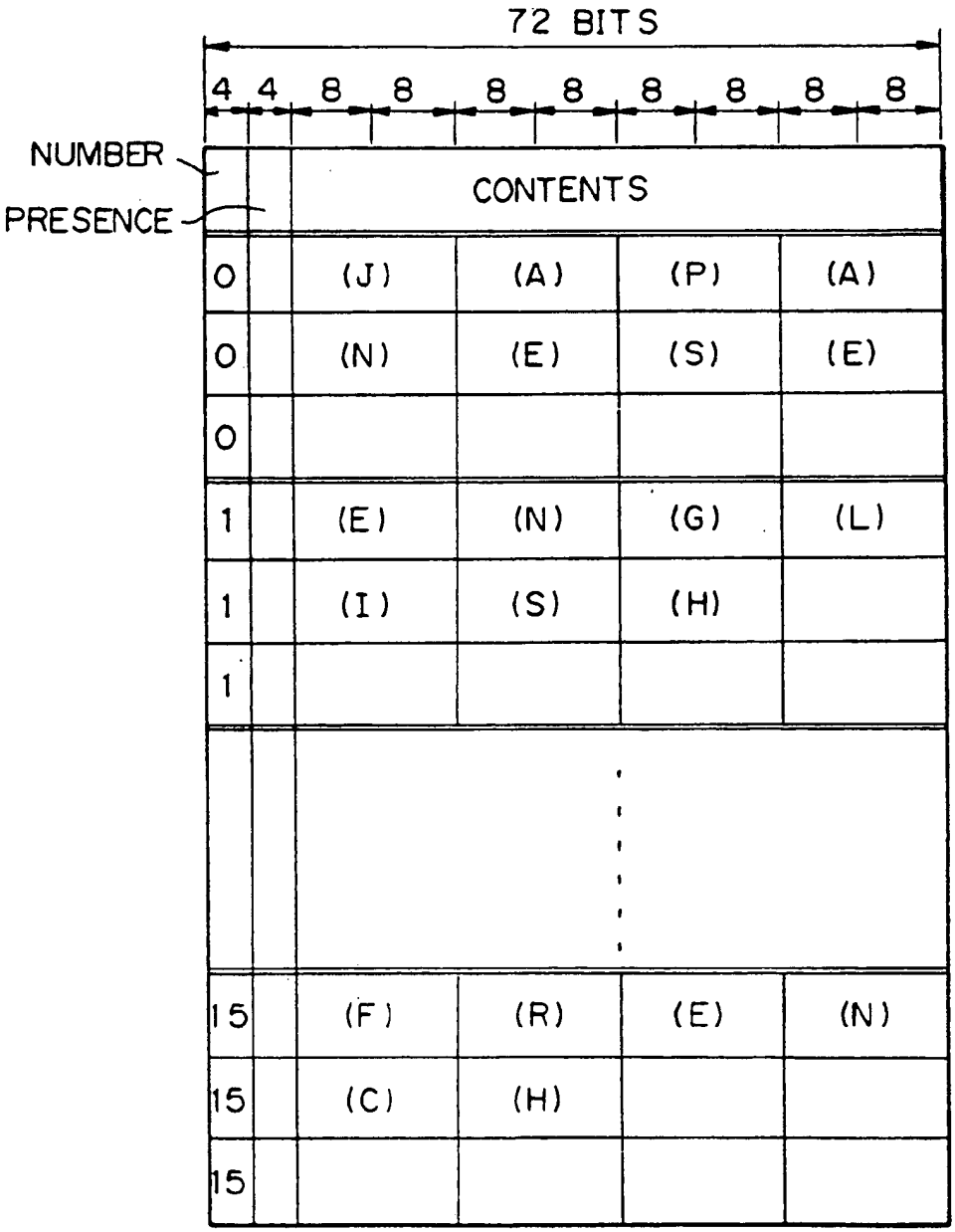

72 BITS
4 4 8 8 8 8 8 8 8 8
NUMBER
PRESENCE
CONTENTS
0 (J) (A) (P) (A)
0 (N) (E) (S) (E)
0
1 (E) (N) (G) (L)
1 (I) (S) (H)
1
15 (F) (R) (E) (N)
15 (C) (H)
15

Fig. 13

Fig. 13A	Fig. 13B
	Fig. 13C

Fig. 13A

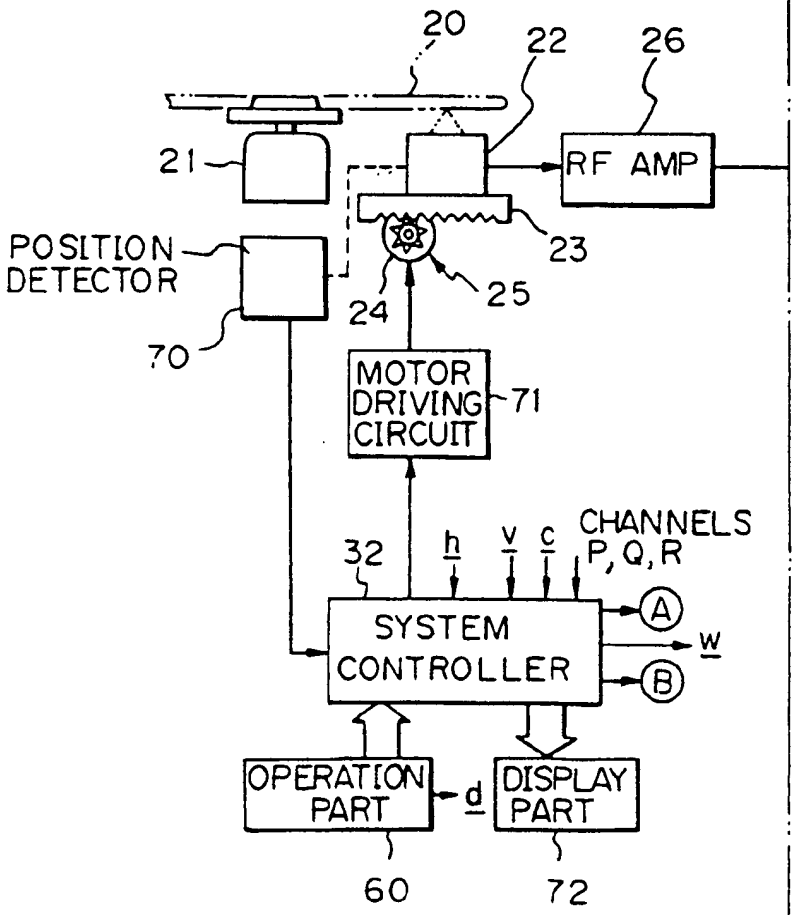


Fig. 13B

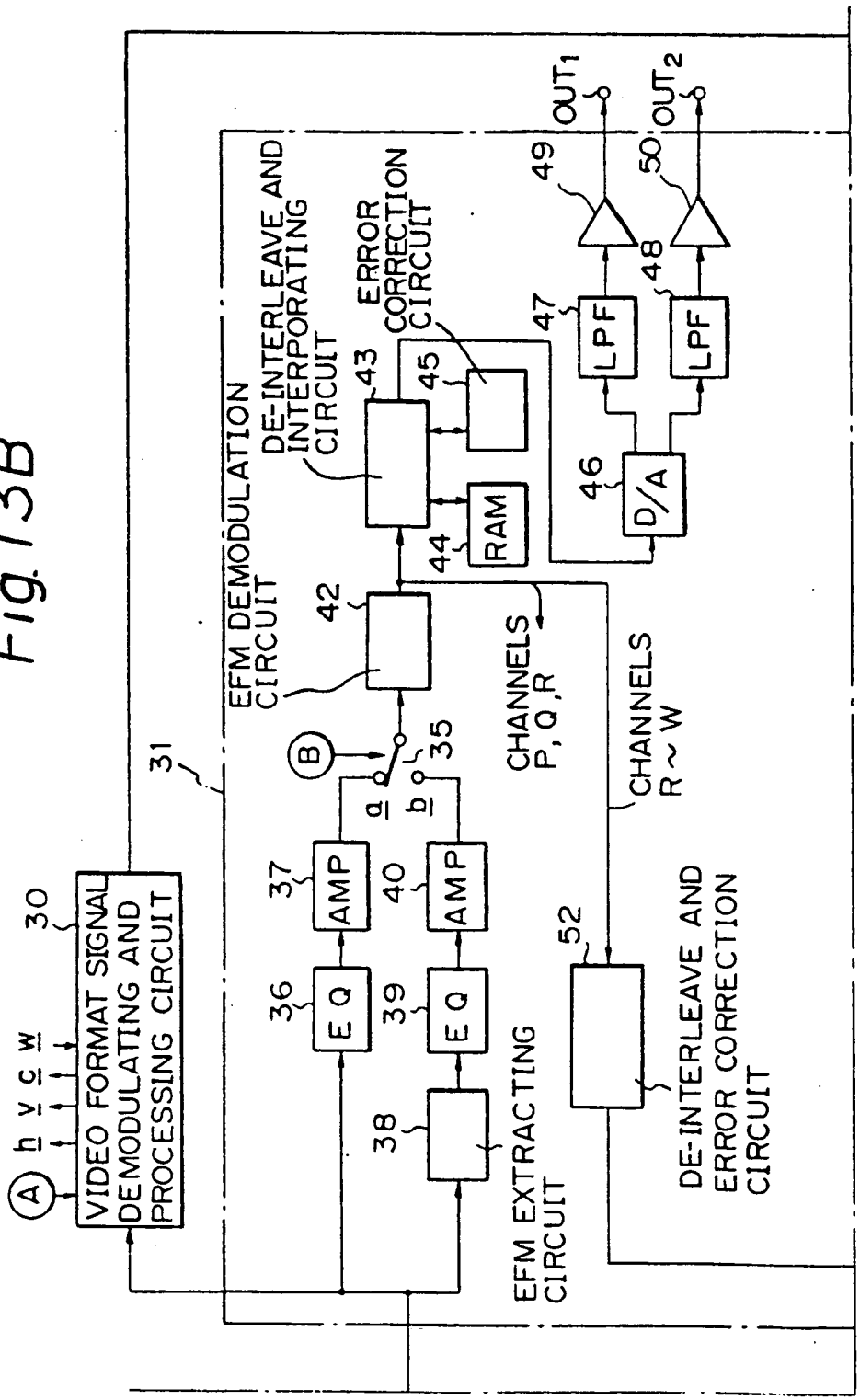

A
h
v
c
w
VIDEO FORMAT SIGNAL DEMODULATING AND PROCESSING CIRCUIT
30
31
EFM DEMODULATION CIRCUIT
DE-INTERLEAVE AND INTERPORATING CIRCUIT
ERROR CORRECTION CIRCUIT
43
45
44
RAM
42
B
35
a
b
37
AMP
40
AMP
36
EQ
39
EQ
38
EFM EXTRACTING CIRCUIT
CHANNELS P, Q, R
CHANNELS R ~ W
52
DE-INTERLEAVE AND ERROR CORRECTION CIRCUIT
46
D/A
47
LPF
48
LPF
49
50
OUT1
OUT2

Fig. 13C

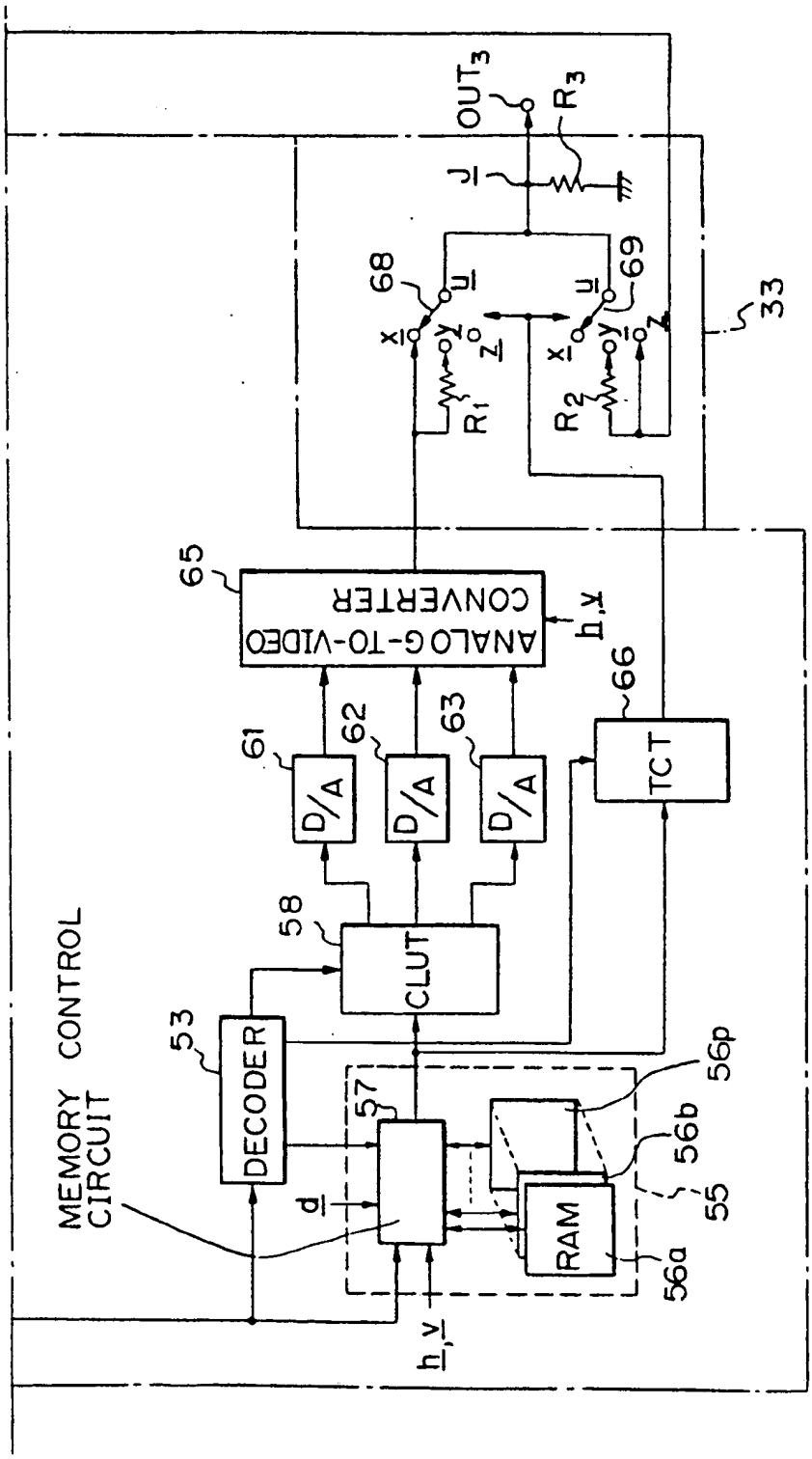

OUT3
R3
J
68
69
33
R1
R2
65
CONVERTER
ANALOG-TO-VIDEO
66
TCT
61
62
63
D/A
D/A
D/A
58
CLUT
53
DECODER
MEMORY CONTROL CIRCUIT
57
56p
56b
55
56a
RAM
d
h, v

Fig. 14

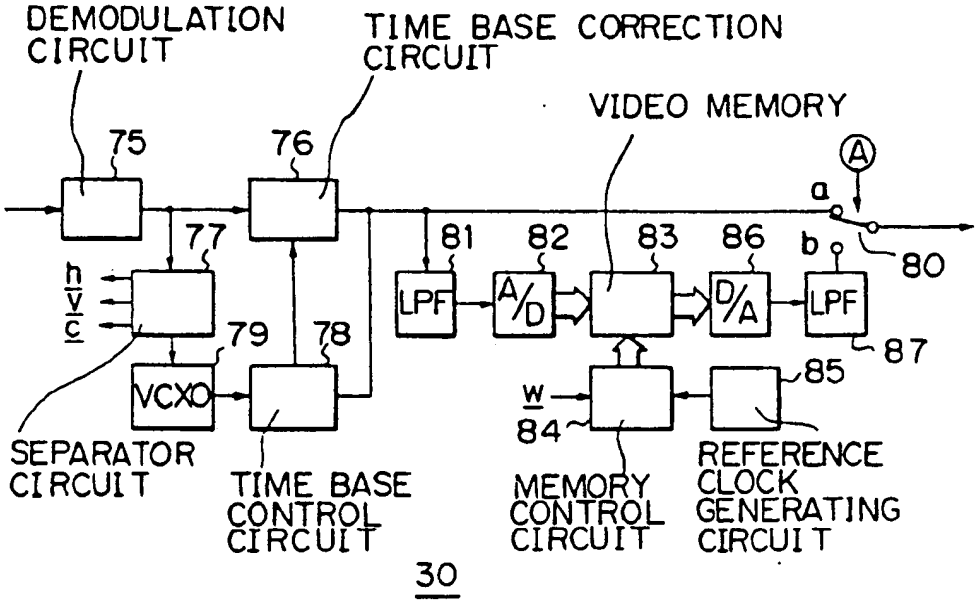

DEMODULATION CIRCUIT
TIME BASE CORRECTION CIRCUIT
VIDEO MEMORY
75
76
77
81
82
83
86
A
a
b
80
h
v
c
LPF
A/D
D/A
LPF
87
79
78
VCXO
85
w
84
SEPARATOR CIRCUIT
TIME BASE CONTROL CIRCUIT
MEMORY CONTROL CIRCUIT
REFERENCE CLOCK GENERATING CIRCUIT
30

Fig. 16

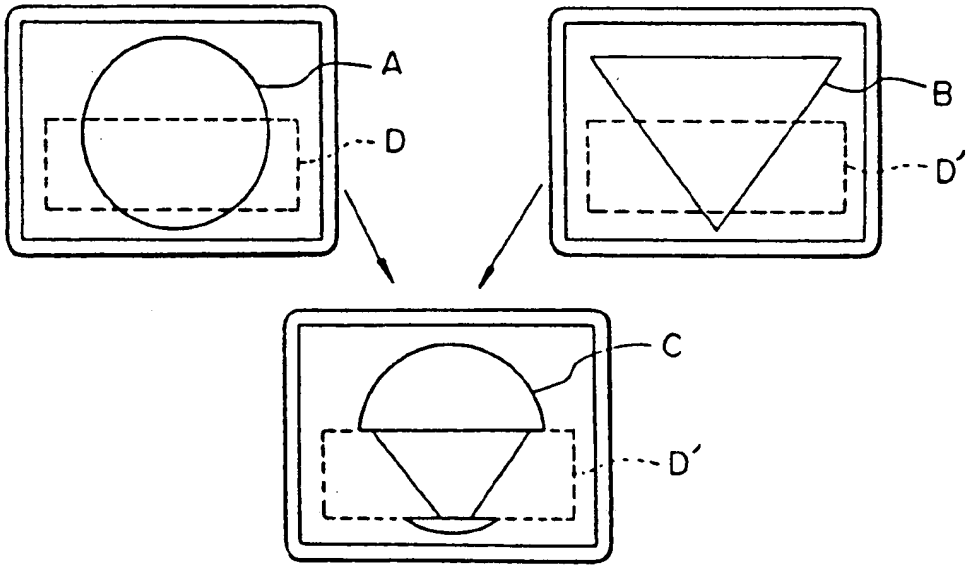

A
D
B
D'
C
D'

Fig. 15 A

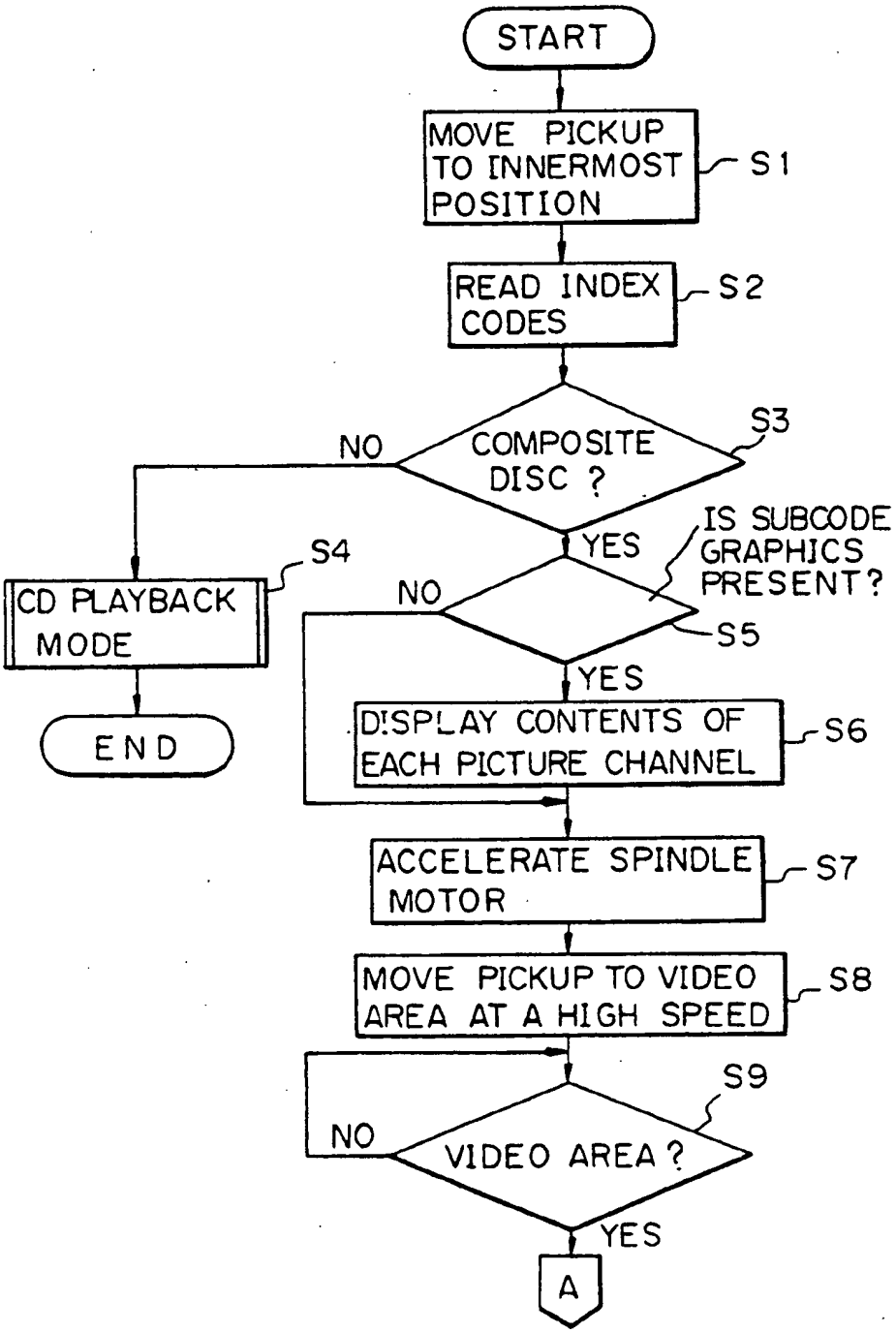

START
MOVE PICKUP TO INNERMOST POSITION
S1
READ INDEX CODES
S2
COMPOSITE DISC ?
S3
NO
YES
CD PLAYBACK MODE
S4
END
IS SUBCODE GRAPHICS PRESENT?
S5
NO
YES
DISPLAY CONTENTS OF EACH PICTURE CHANNEL
S6
ACCELERATE SPINDLE MOTOR
S7
MOVE PICKUP TO VIDEO AREA AT A HIGH SPEED
S8
S9
VIDEO AREA ?
NO
YES
A

Fig. 15B

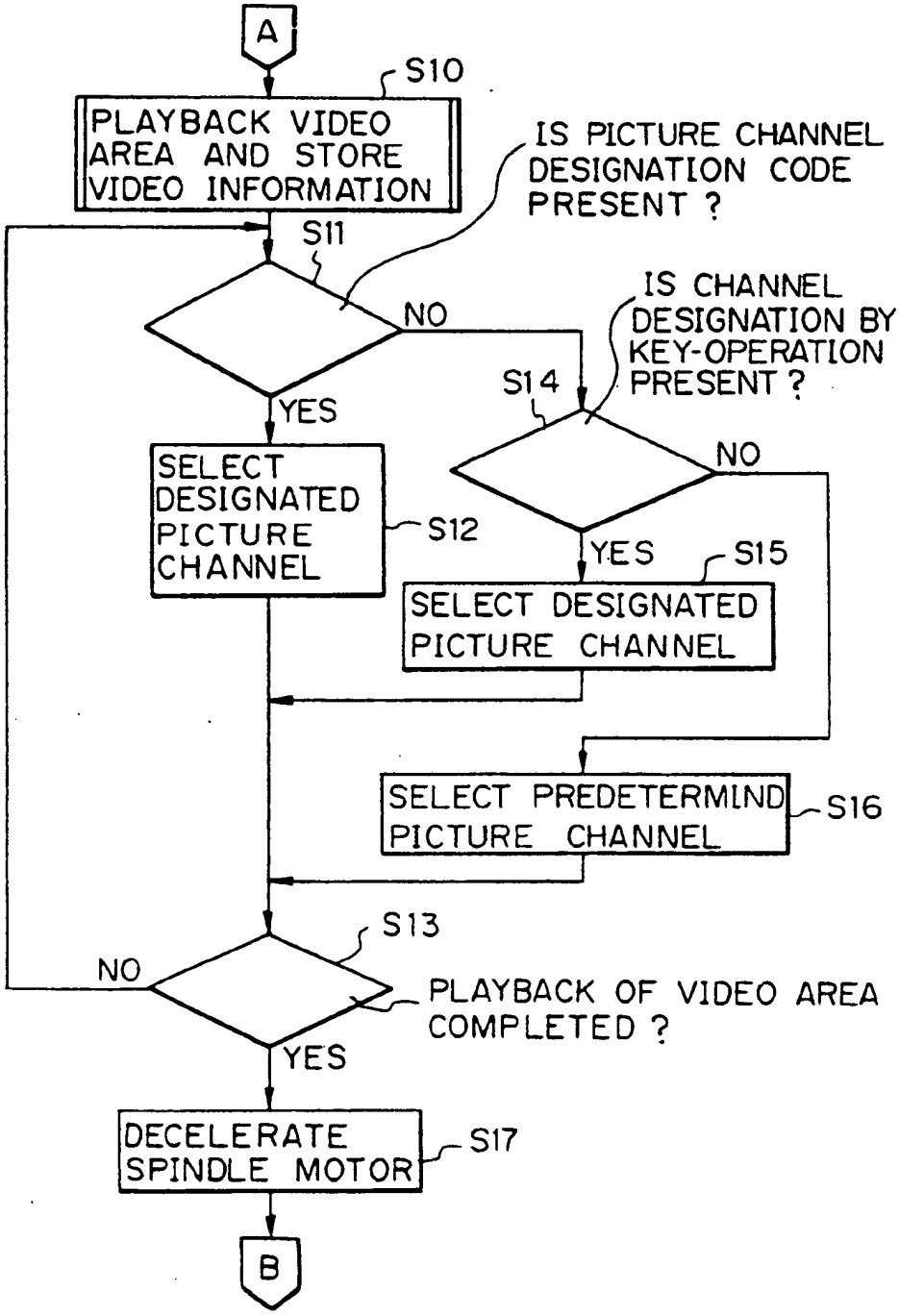

A
S10
PLAYBACK VIDEO AREA AND STORE VIDEO INFORMATION
S11
IS PICTURE CHANNEL DESIGNATION CODE PRESENT ?
NO
YES
IS CHANNEL DESIGNATION BY KEY-OPERATION PRESENT ?
S14
NO
YES
SELECT DESIGNATED PICTURE CHANNEL
S12
S15
SELECT DESIGNATED PICTURE CHANNEL
SELECT PREDETERMIND PICTURE CHANNEL
S16
S13
NO
PLAYBACK OF VIDEO AREA COMPLETED ?
YES
DECELERATE SPINDLE MOTOR
S17
B

Fig. 15C

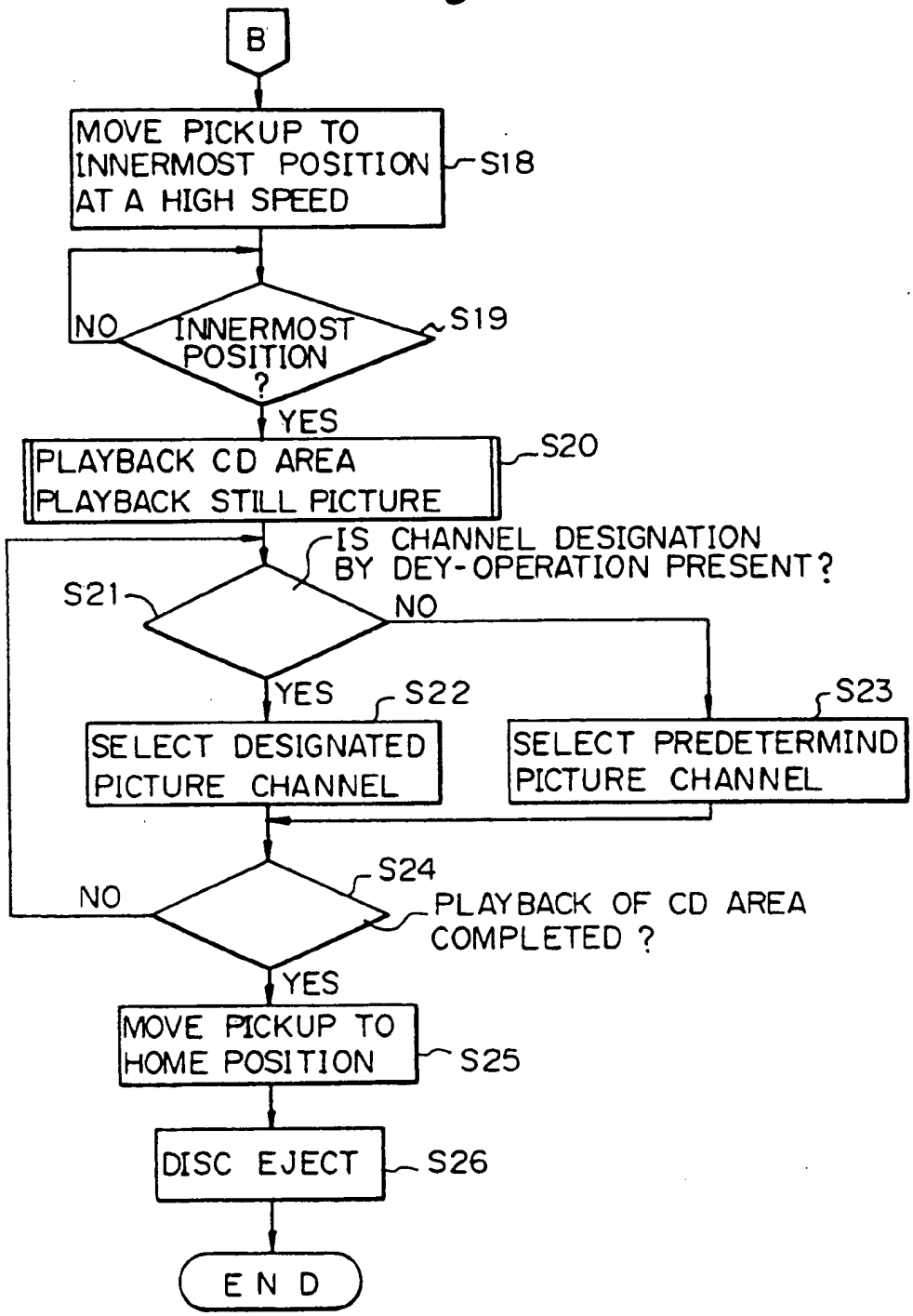

B
MOVE PICKUP TO INNERMOST POSITION AT A HIGH SPEED
S18
NO
INNERMOST POSITION ?
S19
YES
PLAYBACK CD AREA PLAYBACK STILL PICTURE
S20
IS CHANNEL DESIGNATION BY DEY-OPERATION PRESENT?
S21
NO
YES
S22
SELECT DESIGNATED PICTURE CHANNEL
S23
SELECT PREDETERMIND PICTURE CHANNEL
S24
NO
PLAYBACK OF CD AREA COMPLETED ?
YES
MOVE PICKUP TO HOME POSITION
S25
DISC EJECT
S26
END

Fig. 17A

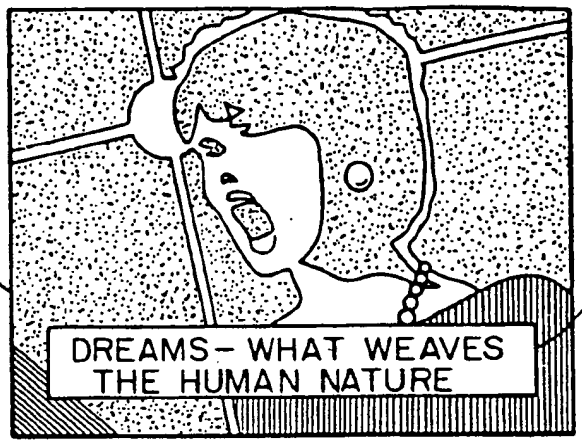


Fig. 17B

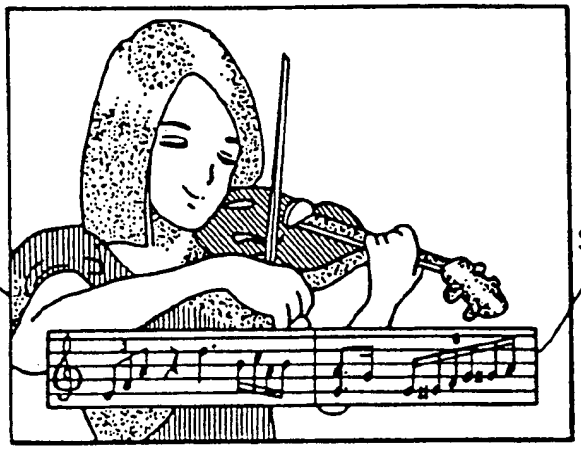


Fig. 17C

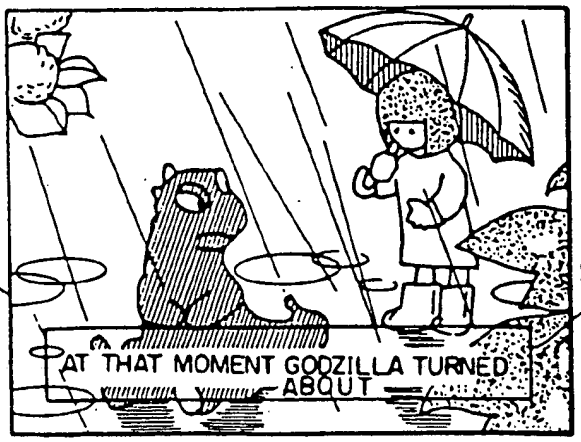


Fig. 18

MODE	ITEM	
0 0 0	0 0 0	ZERO MODE
0 0 1	0 0 0	LINE-GRAPHICS MODE
0 0 1	0 0 1	TV-GRAPHICS MODE
0 0 1	0 1 0	EXTENDED LINE-GRAPHICS MODE
0 0 1	0 1 1	EXTENDED TV-GRAPHICS MODE
1 1 1	0 0 0	USER'S MODE

Fig. 19

SYMBOL	R S T	U V W
0	0 0 1	0 1 0
1	0 1 1	1 0 1
2 3	PARITY Q	
4	0 0 b_3 b_2 b_1 b_0	
5	0 0 b_7 b_6 b_5 b_4	
6 ⋮ 19	0 0 0 0 0 0	
20 ⋮ 23	PARITY P	

Fig. 20

SYMBOL	R S T	U V W
0	0 0 1	0 1 0
1	0 0 0	1 0 0
2 3	PARITY Q	
4	0 0 T_0	COLOR 0
5	0 0 T_1	COLOR 1
6	0 0 0 0	ROW
7	COLUMN	
8 ⋮ 19	FONT	
20 ⋮ 23	PARITY P	

04/15/2004, EAST Version: 1.4.1

Fig. 21

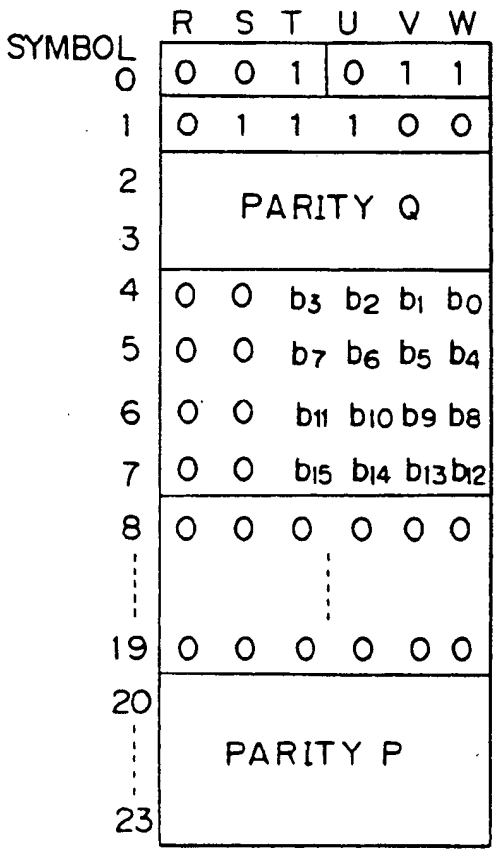

SYMBOL
R S T U V W
0 0 0 1 0 1 1
1 0 1 1 1 0 0
PARITY Q
0 0 b3 b2 b1 b0
0 0 b7 b6 b5 b4
0 0 b11 b10 b9 b8
0 0 b15 b14 b13 b12
0 0 0 0 0 0
0 0 0 0 0 0
PARITY P
0
1
2
3
4
5
6
7
8
19
20
23

Fig. 22

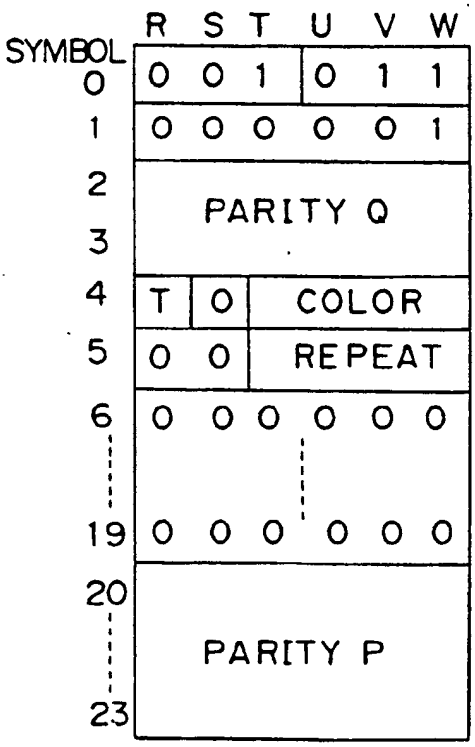

SYMBOL
R S T U V W
0 0 1 0 1 1
0 0 0 0 0 1
PARITY Q
T 0 COLOR
0 0 REPEAT
0 0 0 0 0 0
0 0 0 0 0 0
PARITY P
0
1
2
3
4
5
6
19
20
23

Fig. 23

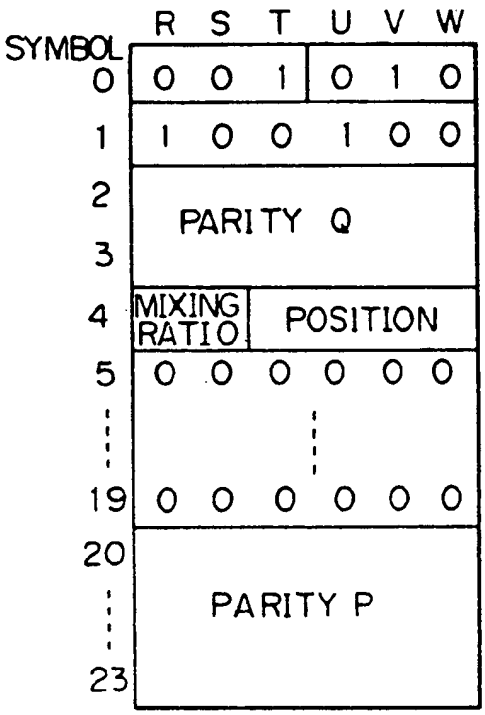


Fig. 24

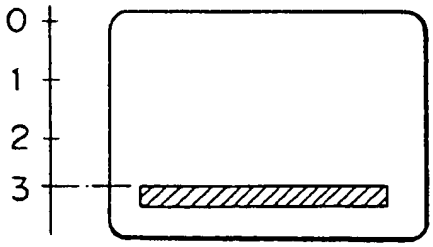


Fig. 25

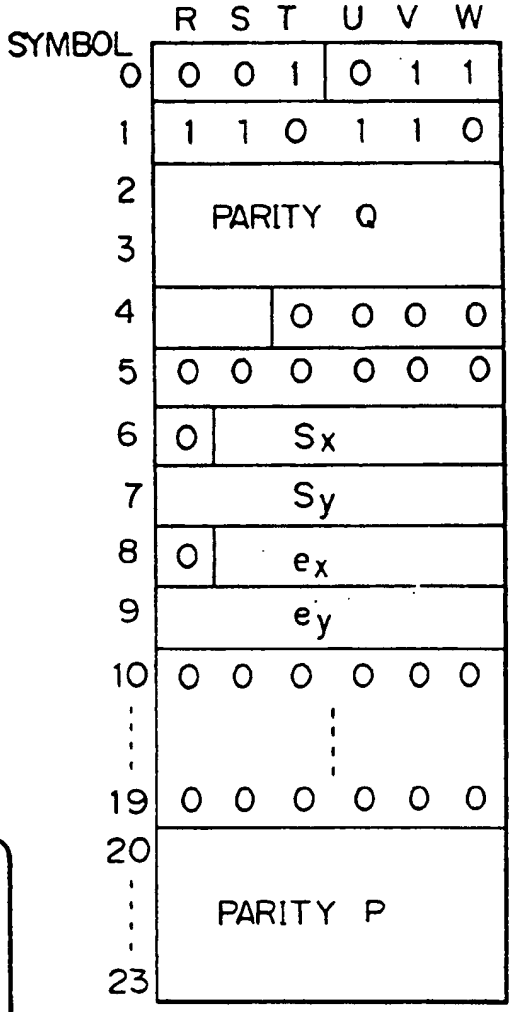


Fig. 26

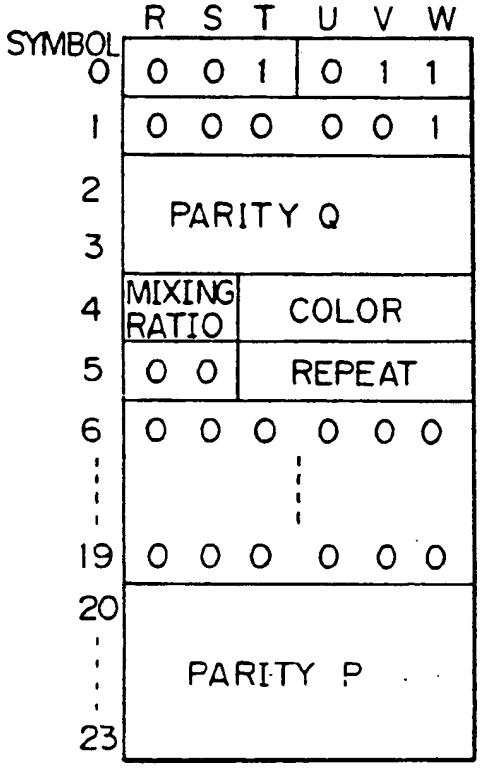


Fig. 27

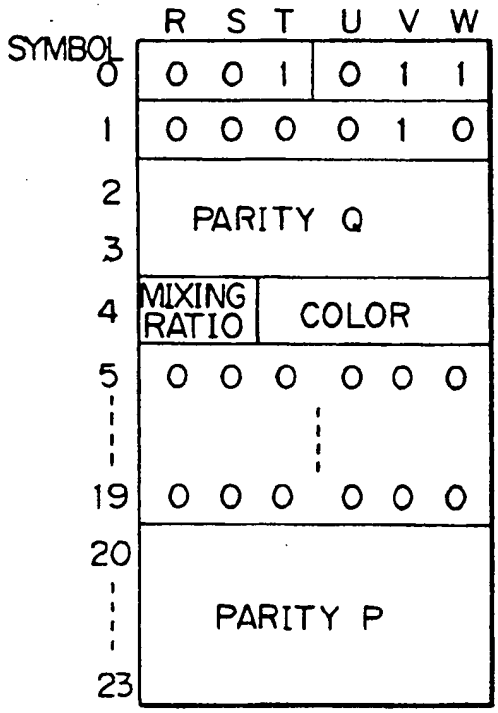


Fig. 28

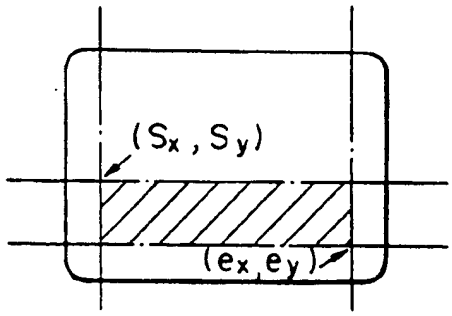


Fig. 29

Fig. 29A	Fig. 29B
	Fig. 29C

Fig. 29A

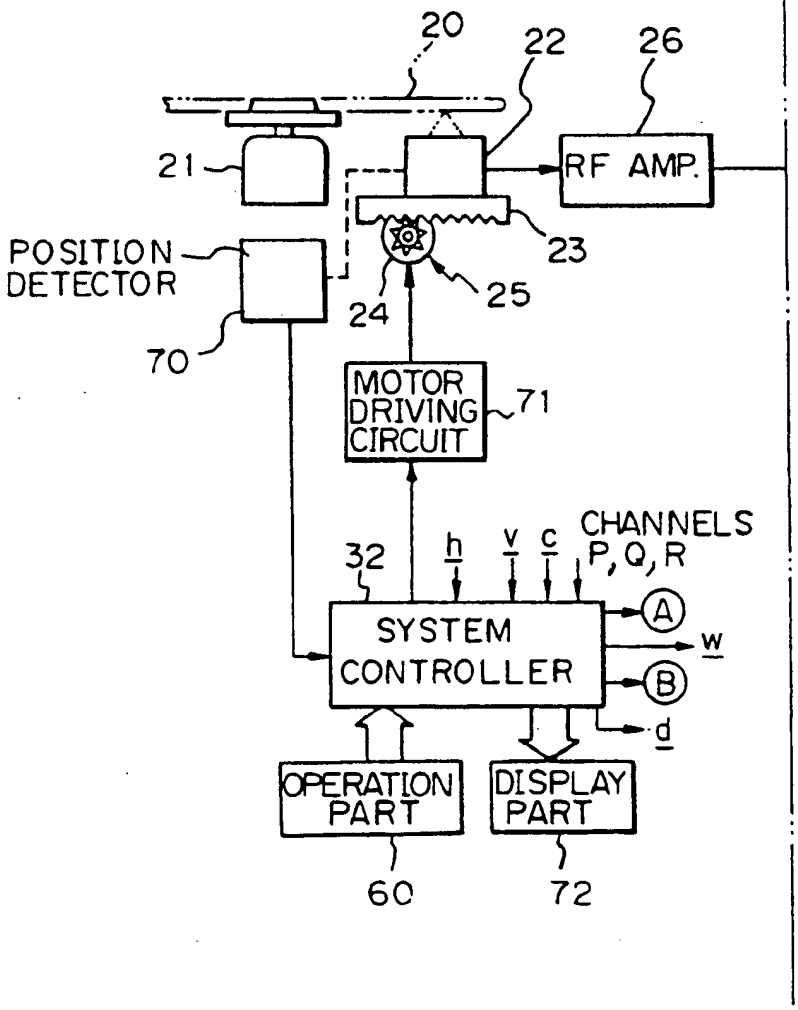


Fig. 29B

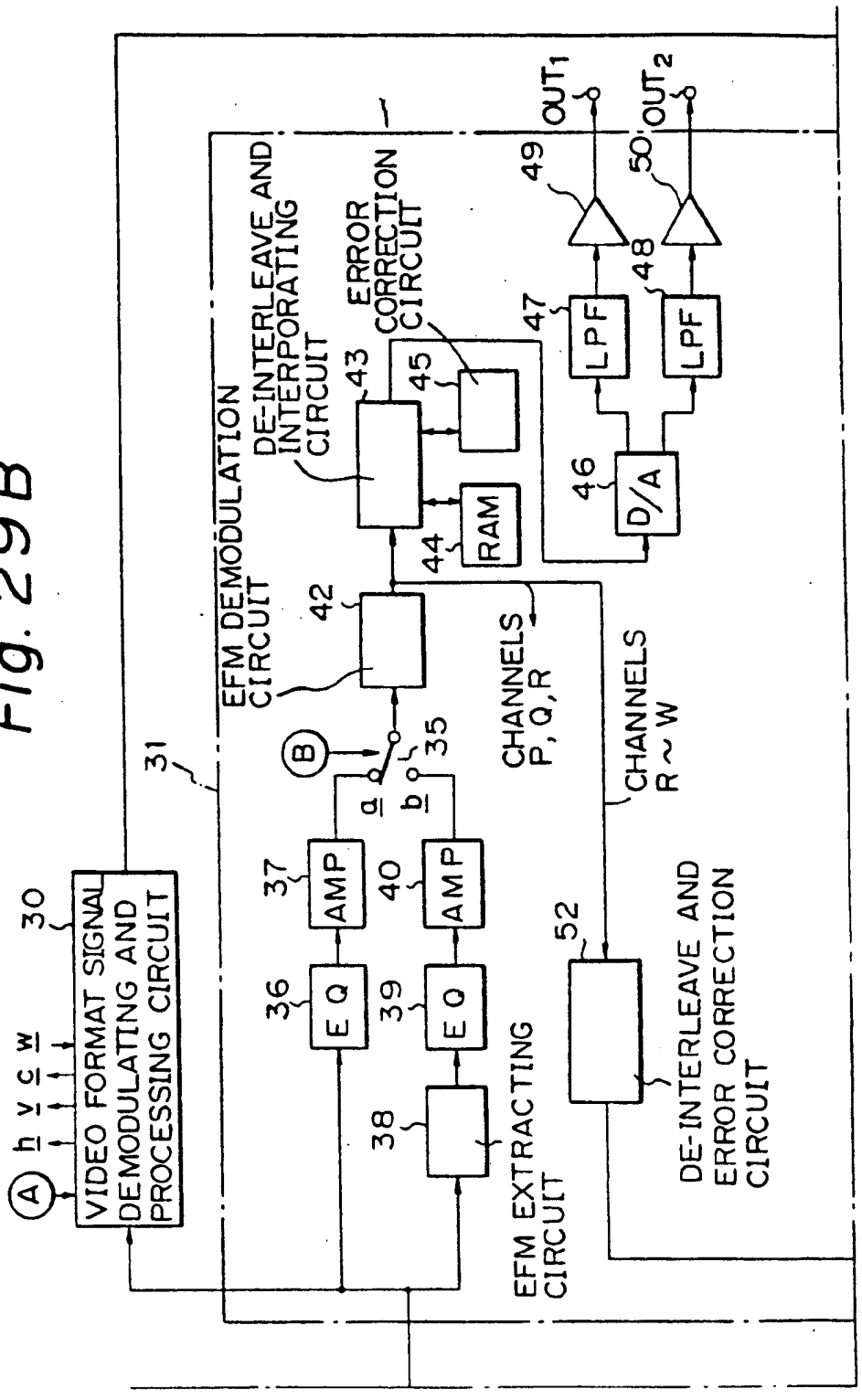
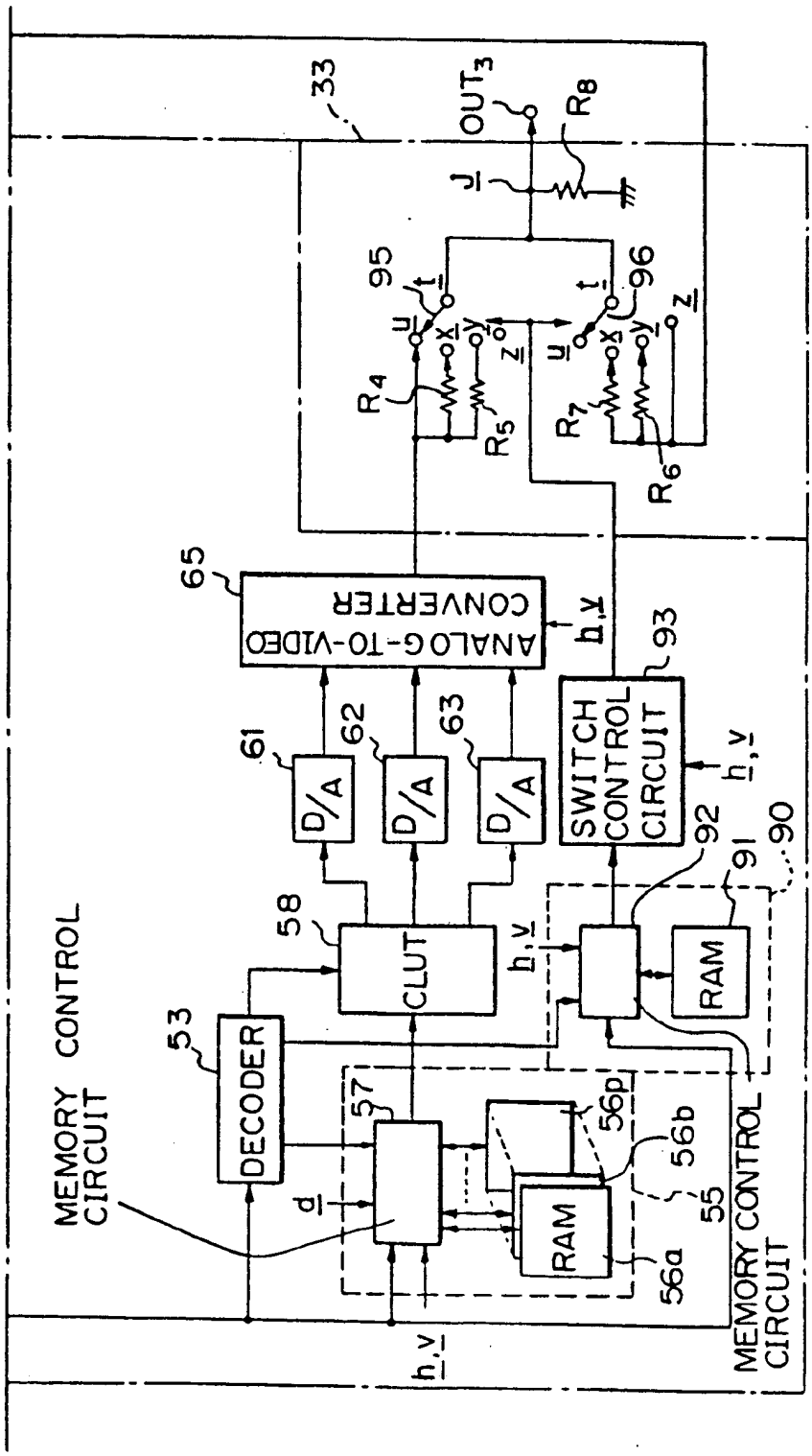

A
h
v
c
w
VIDEO FORMAT SIGNAL DEMODULATING AND PROCESSING CIRCUIT
30
31
B
a
b
35
37
AMP
40
AMP
36
EQ
39
EQ
38
EFM EXTRACTING CIRCUIT
52
DE-INTERLEAVE AND ERROR CORRECTION CIRCUIT
CHANNELS P, Q, R
CHANNELS R ~ W
EFM DEMODULATION CIRCUIT
42
DE-INTERLEAVE AND INTERPORATING CIRCUIT
43
ERROR CORRECTION CIRCUIT
45
RAM
44
D/A
46
LPF
47
LPF
48
49
50
OUT1
OUT2

Fig. 29C


33
OUT3
R8
J
95
96
t
u
x
y
z
R4
R5
R7
R6
65
ANALOG-TO-VIDEO CONVERTER
h,v
93
SWITCH CONTROL CIRCUIT
61
62
63
D/A
D/A
D/A
92
91
90
58
CLUT
RAM
53
DECODER
57
56p
56b
55
56a
d
MEMORY CONTROL CIRCUIT
MEMORY CONTROL CIRCUIT

METHOD OF RECORDING AND REPRODUCING PICTURE INFORMATION, RECORDING MEDIUM, AND RECORDING MEDIUM PLAYING APPARATUS

This application is a continuation of U.S. application Ser. No. 07/860,250 filed Mar. 27, 1992, abandoned, which is a continuation of U.S. application Ser. No. 07/247,351, filed Sep. 21, 1988, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of recording and reproducing picture information on and from a recording medium such as a video disc, a digital audio disc, and so on, and a recording medium, and also relates to a recording medium playing apparatus.

2. Description of Background Information

Systems are proposed in which picture information is recorded and reproduced in the form of the subcode on and from a digital audio disc having a diameter of 12-centimeters, generally designated as the Compact Disc. The subcode is made up of eight subcode bits, and bit groups forming the subcode are divided into eight channels denoted respectively by letters P, Q, R, S, T, U, V, and W. In the method in which the picture information is recorded and reproduced in the form of subcode, data corresponding to picture information is configured such that a symbol is formed by 6 bits of channels R through W out of the 8 bits forming the subcode, and 98 symbols are treated as one block, as illustrated in FIG. 1. Two symbols in the 98 symbols are used as a sync signal, and 24 symbols obtained by dividing the remaining 96 symbols by four are treated as a minimum unit of data, i.e. a "pack", which constitutes one instruction of picture processing.

More specifically, the first symbol (referred to as symbol 0 hereinafter) of the 24 symbols indicates one of several modes. A symbol 1 following this symbol 0 forms instruction which indicates the sort of the instruction. Symbols 2 and 3 following the symbol 1 constitute a parity Q which is an error correction code. Symbols 4 through 19 following the parity Q constitute a data field, and include information such as color information. Finally, symbols 20 through 23 following the data field constitute a parity P which is an error correction code for protecting the information in the "pack".

On the other hand, there are four modes, i.e. "zero mode", "line-graphics mode", "TV-graphics mode", and "user's mode". The "zero mode" is provided for a case where no operation is required for pictures on the display screen, that is, the original image is to be maintained, and all data in the "pack" are 0 for this mode.

The "line-graphics mode" is provided for such a case that a liquid crystal display is provided on the front face of the player, to display notes such as an explanation of a music selection. As shown in FIG. 2, a picture area being long sideways is formed by pixels which are arranged in 288 columns and 24 rows. In other words, each row includes 288 pixels and each column includes 24 pixels. The term "pixel" stands for the minimum display element of a picture, and it is general that the picture processing is performed by using picture composing units designated as "fonts" each of which is made up of pixels divided into 6 columns and 12 rows.

The number of "fonts" which can be displayed in the "line-graphics mode" is 48 in the lateral direction, and 2 in the column direction, and this area is designated as "the screen area". For providing the scroll function, a line of "fonts" is added to the upper and lower outer peripheries and the right and left peripheries of the Screen area, to form a picture area having 50 "fonts" in the direction of row, and 4 "fonts" in the direction of column. The subcode is formed so that the picture processing is performed by using a memory having addresses each corresponding to each pixel in this picture area. In addition, the area outside the Screen area is designated as "border".

The "TV-graphics mode" is a mode for displaying images on the TV screen, and a picture is formed by pixels arranged in 192 rows and 288 columns as illustrated in FIG. 3. The number of "fonts" which can be displayed in the "TV-graphics mode" is 48 in the direction of row, and 16 in the direction of column. Also in this "TV-graphics mode", the subcode is formed so that the picture processing is performed by using a memory having addresses each of which corresponds to each pixel in a picture area having 50 "fonts" in the direction of row, and 18 "fonts" in the direction of column, made by adding a line of "fonts" to the upper and lower peripheries as well as the right and left outer peripheries of the "screen area".

As instructions for the picture processing, there are an instruction for painting out the whole picture area by one certain color, an instruction for drawing a picture in one "font" on the screen by using two different colors, an instruction for moving the whole picture upward or sideways, and so on.

Additionally, in the 8-bit groups forming the subcode, the Q bits forming the channel Q include time information corresponding to the track length to a certain position of each information data which is recorded from the beginning of the program area of CD, and form address time data which can be used as positional data representing the recording position. On the other hand, the P bits forming the channel P form data including information relating to a pause between two music selections.

In the above-described system of recording and reproducing picture information as subcode, the time period necessary for displaying a picture of one "font" is about 3.3/1000 second, and about 2.5 seconds are necessary for displaying 48×16 characters. Therefore, it is not possible to record and reproduce a picture with motion by means of the method explained above. In addition, since the number of colors which can be used in one shot of picture is at most 16 with the conventional method, there has been a shortcoming that the reproduced picture obtained by that method is rather monotonous.

Therefore, if it is attempted to obtain a reproduced picture having variety by mixing a signal corresponding to the picture information recorded as the subcode and a video format signal generated separately, that will cause a sense of incompatibility unless there is some mutual relationship between the picture information recorded as the subcode and the video format signal. As a result, it become necessary, for example, to synchronize timings of start of generation of the signal corresponding to the picture information recorded as the subcode and the video format signal, by a manual operation. Thus, it was difficult to obtain a reproduced picture having variety which does not cause the sense of incompatibility.

OBJECT AND SUMMARY OF THE INVENTION

The present invention is based on the point described above, and an object of the present invention is to provide a method of recording and reproducing picture information by which a reproduced picture having variety and causing no sense of incompatibility is easily obtained.

Another object of the present invention is to provide a recording medium on which picture information is recorded according to the method of the invention and an apparatus for playing such a recording medium.

A method of recording and reproducing on and from a recording medium picture information according to the present invention is characterized by the steps of recording, in addition to a video format signal and a coded information signal, graphic codes including picture information which occupies at least one of N (N being a natural number equal to or larger than 2) channels, by inserting the graphic codes as the subcode of the coded information signal in a first area of the recording medium, recording identification code information of at least one of the channels in a second area of the recording medium, and at the time of reproduction of the recording medium, displaying the identification code information, and mixing a picture signal corresponding to graphic codes occupying a channel, which is designated by a picture channel command for designating one of the group of channels, in the video format signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram showing the recording format of subcode data;

FIG. **2** is a diagram showing the structure of picture in the "line-graphics mode";

FIG. **3** is a diagram showing the structure of picture in the "TV-graphics mode";

FIG. **4** is a diagram showing the sort of recording mode in the method according to the present invention;

FIG. **5** is a diagram showing the structure of "load transparency control table" instruction;

FIG. **6** is a diagram showing the correspondency between the bit pattern of TCB and the mixing ratio;

FIG. **7** is a diagram showing "load color look-up table color 0 through color 7" instruction;

FIG. **8** is a diagram showing the structure of "write font foreground/background" instruction;

FIG. **9** is a block diagram showing an example of the construction of recording apparatus;

FIG. **10** is a diagram showing recording area of a composite disc;

FIG. **11** is a diagram showing the format of channel R of the subcode recorded in a lead-in area;

FIG. **12** is a diagram showing the format of the data field;

FIGS. **13A** through **13C**, when combined, are a block diagram showing an apparatus for reproducing picture information recorded on a disc in accordance with recording and playback method according to the present invention;

FIG. **13** is a diagram showing the arrangement of FIGS. **13A** through **13C**;

FIG. **14** is a block diagram showing a specific configuration of video format signal processing circuit **30** in the apparatus shown in FIGS. **13A** through **13C**;

FIGS. **15A–15C**, when combined, are a flowchart showing the operation of processor in system controller **32** of the apparatus shown in FIGS. **13A** through **13C**;

FIGS. **16** and **17A** through **17C** are diagrams showing pictures obtained by the apparatus shown in FIG. **13A** through **13C**;

FIG. **18** is a diagram showing recording mode in another embodiment of the present invention;

FIG. **19** is a diagram showing the structure of "set TCW" instruction;

FIG. **20** is a diagram showing the structure of "write font" instruction;

FIG. **21** is a diagram showing another structure of "set TCW" instruction; and

FIG. **22** is a diagram showing the structure of "preset memory" instruction;

FIG. **23** is a diagram showing the structure of "set window" instruction in "extended line-graphics mode" in another embodiment according to another embodiment of the present invention;

FIG. **24** is a diagram showing the window in "extended line-graphics mode";

FIG. **25** is a diagram showing the structure of the "set window" instruction in the "extended TV-graphics mode";

FIG. **26** is a diagram showing the structure of the "pre-set" instruction in the another embodiment;

FIG. **27** is a diagram showing the structure of "preset border" instruction;

FIG. **28** is a diagram showing the window in "extended TV-graphics mode";

FIGS. **29A** through **29C**, when combined, are a block diagram showing an apparatus for reproducing picture information recorded on a disc by the recording and reproducing method according to the present invention; and

FIG. **29** is a diagram showing the arrangement of FIGS. **29A** through **29C**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

An embodiment of the method according to the present invention will be explained with reference to FIGS. **4** through **28** of the accompanying drawings.

As shown in FIG. **4**, a code to be inserted as the symbol **0** is set in order to designate an additional mode, that is, "graphic mode with motion picture" in addition to the "zero mode", the "line-graphics mode", the "TV-graphics mode" and the "user's mode" which are also used in conventional methods.

The structure of picture in the "graphics mode with motion picture" is identical with that in the "TV-graphics mode", and an instruction designated as "load transparency control table" is provided. This "load transparency control table" instruction is an instruction for designating the mode for each pixel in picture area. Three modes are designated by this instruction, and those are namely, "transparent mode", "mixing mode", and "non-transparent mode". In these three modes, different values are selected for the mixing ratio between a video format signal obtained by the subcode and a video format signal which is recorded by multiplexing together with the coded information signal including the subcode.

The bits in the channels R through W of each of the symbols **4** through **8** and the channels R and S of the symbol **9** constitute a series of codes TCB-0 through TCB-15 which respectively designate one of modes

which will be described later for each of the group of pixels to which one of colors, which are registered as color number "0" through color number "15", is allotted. FIG. 6 shows a relationship between bit patterns of the codes TCB-0 through TCB-15 and the modes designating the mixing ratio, and the mixing ratio in each mode.

In addition, the sixteen colors indicated by the color number "0" through "15" are set by a "load CLUT color 0 through color 15 (load color look-up table color 0 through color 15)" instruction. The "load CLUT color 0 through color 15" instruction is an instruction having a structure illustrated in FIG. 7, and setting the contents of a color look-up table showing the color of preset color numbers or foreground/background color numbers. It is necessary to designate sixteen colors in total. However, since four bits are used respectively for each of RGB to indicate a color, two symbols are required for setting one color. Therefore, eight colors are set by one Pack at most. With this circumstances, this instruction is divided into two instructions respectively designating eight colors of the first half, and eight colors of the second half.

The instruction code for the colors of the first half, i.e. the color 0 through the color 7, is determined to be "30", and the instruction code for the colors of the second half, i.e. the color 8 through color 15 are determined to be "31". The mixing of colors for each of the color number is as follows. Red color is represented by four bits of the channels R through U of even symbols allotted to the color number. Green color is represented by four bits, i.e. two bits of the channels V and W following the channels R through U of the even symbols, and two bits of the channels R and S of odd symbols. Blue color is represented by four bits of channels T through W following the channels R and S of the odd symbols. Therefore, 2^4 (=16) sorts of gray scales are available for each color, and preparation of 16^3 (=4096) colors is possible since three colors (RGB) are used. In addition, a gray scale "0000" corresponds to the darkest state, and a gray scale "1111" corresponds to the brightest state.

On the other hand, a "write font foreground/background" instruction is used in the "TV-graphics mode", which has such a structure as illustrated in FIG. 8. This is an instruction for writing font data of the symbols 8 through 19 in positions having a row-address defined by the symbol 6 and a column-address defined by the symbol 7. For the pixels whose font data is "0", a color of a color number determined by the "color 0" is designated as a background color. For the pixels whose font data is "1", a color of a color number defined by "color 1" is designated as a foreground color. At the same time, subpicture channels can be designated by using four bits of the channels R and S of the symbols 4 and 5. By this feature, as many as sixteen picture channels can be designated. Sixteen sorts of picture are previously recorded on a disc for example, and on the playing side, a desired picture channel can be selected at the time of playing by this scheme of designating the picture channel.

FIG. 9 shows an apparatus for recording the above explained codes on a recording disc by inserting the codes in the subcode.

In the arrangement shown in FIG. 9, two-channel audio signals and a video format signal outputted from a video tape recorder for example, are respectively supplied to input terminals IN_1, IN_2, and IN_3. The video format signal is supplied to an FM modulator 1. In the FM modulator 1, a carrier signal of a predetermined frequency is FM-modulated by the video format signal. An FM signal outputted by this FM modulator 1 is supplied to a multiplexing circuit 3. On the other hand, left and right-channel audio signals are supplied to an analog-to-digital converting circuit 4. The analog-to-digital converting circuit 4 is configured to perform the sampling of each of the left and right-channel audio signals at a sampling frequency of 44.1 MHz for example, to generate two digital data corresponding to two sampled values obtained by the sampling, and to output the digital data after treating them by time division multiplexing. The output data of this A/D converter 4 is supplied to a CD system encoder 6 through an error correction code adding circuit 5 which performs the interleave of the data, the error detection, and addition of codes for the error correction. To the CD system encoder 7, an output signal of the control signal generating circuit 7 and an output signal of the error detection and correction code adding circuit 8 are supplied. The control signal generating circuit 7 is configured to generate data such as a data indicating the time elapsed after the start of the supply of audio signals to the input terminals IN_2 and IN_3, and a data indicating a pause between music selections or a portion within one music selection of the audio signals.

On the other hand, output data of the graphic/instruction code generation device 9 is supplied to the error correction and correction code adding circuit 8. The graphic/instruction code generation device is configured to record a plurality of codes which are previously inputted by key operations for example, and to read-out and output desired codes. The error detection and correction code adding circuit 8 is configured to perform the interleave and error detection of the output data of the graphic/instruction code generation device 9 and the addition of the correction code.

The CD system encoder 6 is configured to form a recording signal by making the output of the control signal generation circuit 7 data of the channels Q and P, and making the output of the graphic code generating device through the error detection and correction code adding circuit 8 data of the channels R through W, and inserting those data into the digital data from the A/D converter 4. Output signal of this CD system encoder 6 is supplied to a modulator 10 and converted to an EFM (Eight to Fourteen Modulation) modulation signal. The output signal of this modulator 10 is supplied to the multiplexing circuit 3, and processed by a frequency multiplexing with the FM-modulated video format signal.

The output signal of the multiplexing circuit is supplied to an optical disc recorder of known arrangement (not shown) in which the strength of a light beam irradiated on the recording surface of a disc rotated at a constant linear velocity for example, is modulated by this signal. As a result, the graphic codes including picture information and the instruction codes are recorded on the recording disc as the subcode of the digital audio signal, in addition to the video format signal and the digital audio signal as the coded information signal.

FIG. 10 shows a composite disc 20 carrying a digital audio signal functioning as the coded information signal into which the subcode including picture information is inserted as explained above. As shown, the composite disc 20 has a first area 20*a* disposed in an inner peripheral area of the disc (this area being referred to hereinaf-

ter as the CD area) in which is recorded a digital audio signal with the subcode including picture information being inserted, and a second recording area 20*b* (this area being referred to hereinafter as the video area) containing an FM-modulated video format signal and a superimposed digital audio signal with the subcode including picture information being inserted, wherein the superimposition is performed by using a frequency multiplexing system. Since the video format signal contains higher frequency components than the PCM signal, it is necessary to rotate the disc at a higher speed of rotation during the recording of signals in the video area 20*b*, than during the recording of the signal in the CD area 20*a*. Therefore of course it is necessary, in the playing time, to reproduce the signal by rotating the disc at the higher speed during the playback of video area 20*b*, than during the playback of CD area 20*a*. The speed of disc rotation during the playback of CD area 20*a* is several hundred r.p.m., whereas during the video area playback the speed of rotation is two thousand plus several hundred r.p.m. for playback from the innermost periphery of that area, and is one thousand plus several hundred r.p.m. for playback from the outermost periphery of that area, so that the speed of rotation is extremely high during video area playback.

In the head portions of the CD area 20*a* and the video area 20*b*, there respectively are provided a lead-in area in which are recorded, as the subcode, index codes relating to the contents recorded in each area, such as first and second code groups formed correspondingly to each area by the repetition of index codes which respectively indicate start and end times of small portions which together constitute each area. In addition, the index codes of the audio lead-in area include information showing whether the disc itself is a composite disc or a disc of other type.

The channel R bits, for example, of the subcode recorded in the audio lead-in area has the same format as the channel Q bits as illustrated in FIG. **11**. Specifically, the number of bits of the channel R in one subcode frame is **98** as in the case of the other channels, in which 2 bits are used to form the sync signal and remaining 96 bits are divided into four fields, namely control field, address field, data field, and CRCC field.

The bits in the data field is used to form a code indicating the channel number of the picture channels 0 through 15, a code indicating the presence or absence of the picture information, and codes respectively corresponding to each character of a character group having 8 characters representing the contents of the picture information.

On the other hand, channel designation data for designating the picture channel are inserted, as a control signal, in portions corresponding to predetermined horizontal scanning lines in the vertical fly-back period of the video format signal recorded in the video area 20*b*.

FIGS. **13A** through **13C** show a disc player for playing a composite disc which has been explained above. As illustrated in these figures, a disc **20** is rotated by a spindle motor **21**, and information recorded thereon is read-out by means of a pickup **22**. The pickup **22** incorporates therein an optical system including a laser diode, an objective lens, and photo detectors, a focus actuator for driving the objective lens in a direction of its optical axis with respect to the information recording surface of the disc **20**, a tracking actuator for biasing the beam spot (information detecting point) issued from the pickup **22** with respect to the recording tracks in a direction of disc radius, and so on. The pickup **22** is mounted on a slider **23** which is movable in the direction of disc radius by a direct drive of a transmission mechanism **25** which in turn has a slider motor **24** as a source of driving force, and made by a combination of rack and pinion gears. A read-out RF (radio frequency) signal outputted by the pickup **22** is supplied to a video format signal demodulating and processing circuit **30** and a coded information demodulating and processing circuit **31** through an RF amplifier **26**.

The video format signal demodulating and processing circuit **30** includes a demodulation circuit which for example demodulates the RF signal and converts it to a video format signal and a memory which stores the video format signal after digitizing it, and configured to selectively output one of the video format signal outputted by the demodulation circuit and the video format signal read-out from the memory in accordance with a changeover command from a system controller **32**. The video format signal outputted by the video format signal demodulating and processing circuit **30** is supplied to a video switch **33**. In addition, the video format signal demodulating and processing circuit **30** is further provided with a separating circuit which separately extracts a horizontal sync signal h, a vertical sync signal v, and control data c from the demodulated video format signal, and the separated horizontal and vertical sync signals h and v, and the control data c are supplied to each part such as the system controller **32**.

On the other hand, the coded information demodulating and processing circuit **31** is provided with a selector switch **35** which changes its switch position in accordance with the area to be played (the CD area or the video area) during the playing of a composite disc. The selector switch **35** is operated to a position a during the playing of the CD area, and to a position b during the playing of the video area, and the changeover is performed in response to a changeover command issued from the system controller **32**. In the case of the composite disc, the speed of disc rotation changes extremely between the CD area and the video area, and the PCM audio signal is for example an EFM (Eight to Fourteen Modulation) signal. For the video area, the EFM signal will adversely affect on the low frequency component of the video signal treated by the FM modulation process if the digital signal is directly superimposed on the FM video signal at the time of recording. Therefore, the digital signal, i.e. the EFM signal is recorded at a level which is lower than the video carrier level by several tens of dB, although the degree of modulation is almost the same for the EFM and video signals. Thus the frequency characteristic and amplitude of a playback EFM signal will both be different, for the cases of CD area playback and video area playback respectively. However, a common demodulating system is used for the CD area playback and the video area playback. This is made possible by switching signal processing systems for the playback EFM signals of the CD area and the video area respectively.

Specifically, during playback of the CD area, the playback RF signal is an EFM signal, which is subjected to frequency characteristic compensation by an equalizer circuit **36** having a predetermined equalizing characteristic, and is amplified at a predetermined amplification factor by an amplifier **37**. During the playing of the video area, on the other hand, the playback RF signal is an FM video signal which is combined with an EFM signal. The EFM signal is extracted by an EFM

signal extracting circuit **38** which is made up of an LPF and so on, then is subjected to frequency characteristic compensation by an equalizer circuit **39**, which has a different equalization characteristic from the equalizer circuit **36**, to be then amplified by an amplifier **40**, which has a higher gain than that of the amplifier **37**. In this way, an EFM signal is derived whose frequency characteristic and amplitude are almost the same as the EFM signal obtained during CD area playback.,

During playback of a CD disc, the selector switch **35** is held in position a.

The playback EFM signal selected by the selector switch **35** is supplied to an EFM demodulation circuit **42** which performs the demodulation process, to obtain a PCM data that is digital data including audio information of left and right channels which is for example time-division multiplexed, and the subcode. The digital data including audio information outputted by this EFM demodulation circuit **42** is supplied to a de-interleave and interpolating circuit **43**. The de-interleave and interpolating circuit **43** is configured to change back, in cooperation with the RAM **44**, the order of the digital data which was rearranged by the interleave operation during the recording, in turn send it to an error correction circuit **45**, and to effect the interpolation of erroneous data in the output data of the error correction circuit **45** by the average value interpolation method for example, when a correction inability signal is outputted. The error correction circuit **45** is configured to perform the error correction operation by using the CIRC (Cross Interleave Reed Solomon Code), and supply the digital data to the de-interleave and interpolating circuit **43**, or supply the digital data to the de-interleave and interpolating circuit **43** together with the correction inability signal when the error correction is not possible. The output data of the de-interleave and interpolating circuit **43** is supplied to a D/A (Digital to Analog) converting circuit **46**. The D/A converting circuit **46** includes a de-multiplexer which separates from each other the digital data of left and right-channel audio information combined by the time division multiplexing, and left and right-channel audio signals are reproduced. After their unnecessary components are removed at LPFs (Low Pass Filters) **47** and **48**, the reproduced left and right-channel audio signals are supplied to audio output terminals OUT_1 and OUT_2 through amplifiers **49** and **50**.

On the other hand, in the subcode outputted by the EFM demodulating circuit **42**, the bit of the channel R is supplied to the system controller **32** and a de-interleave and error correction circuit **52**. Also, in the subcode outputted by the EFM demodulating circuit **42**, two bits of the channels P and Q are supplied to the system controller **32** only, and six bits of the channels R through W are supplied to the de-interleave and error correction circuit **52** only. In the de-interleave and error correction circuit **52**, the de-interleave of the six bits of the channels R through W and the error correction using the parity Q and P are performed. Output data of the de-interleave and error correction circuit **52** is supplied to a mode/instruction decoder **53**. The mode/instruction decoder **53** is configured to decode the mode represented by the three bits of the channels R through T of the symbol **0** of each pack, the mode designated by the item represented by the three bits of the channels U through W of the symbol **0** of each pack, and the instruction represented by the six bits of the channels R through W of the symbol I of each pack, and to supply to each part signals respectively indicative of the modes and the instruction.

Furthermore, the output data of the de-interleave and error correction circuit **52** is supplied to a picture memory device **55**. The picture memory device **55** includes sixteen RAMs **56***a* through **56***p* having addresses respectively corresponding to all pixels on a picture having 50 "fonts" by 18 "fonts" in the row and column directions, and four bits of data can be stored in each address, and a memory control circuit **57** for sensing data indicating the color number of each pixel of each picture channels in the output data of the de-interleave and error correction circuit **52** by using the kind of the modes and the instruction indicated by the output of the mode/instruction decoder **53** and writing them in the corresponding addresses of the RAMs **56***a* through **56***p*, and for reading out sequentially in a predetermined order one memory content of the RAMs **56***a* through **56***p* corresponding to the picture channel designated by a channel designation data d outputted by the system controller **32** in accordance with horizontal and vertical sync signals.

The data outputted by the picture memory device **55** is supplied to a color look-up table **58** (this table being referred to hereinafter as the CLUT). The CLUT **58** is configured to detect the "load CLUT color 0 through color 7" instruction and the "load CLUT color 8 through color 15" instruction from the output data of the de-interleave and error correction circuit **52** in accordance with the kind of the modes and the instruction indicated by the output signal of the mode/instruction decoder **53**, and hold the color data corresponding to each color number, and configured to select and output color data of the color number designated by the data read-out from the picture memory **55**.

The output data of this CLUT **58** is made up of three data respectively representing the level of one of the R, G, B color signals by using four bits. The three data outputted by the CLUT **58** and indicating the levels of the R, G, B color signals are supplied to D/A converting circuit **61**, **62**, and **63**, and converted to analog signals. Output signals of these D/A converting circuits **61** through **63** are supplied to an analog-to-video converting circuit **65**. The analog-to-video converting circuit **65** is configured, for example, to form a video signal of the NTSC system by the steps of obtaining a luminance signal and two color difference signals by the output signals of the D/A converting circuits **61** through **63**, generating a color carrier signal by adding signals obtained by the parallel modulation of two color subcarrier signal having a phase difference of 90° by means of the two color difference signals, and combining the color carrier signal and the luminance signal by the summation, and adding sync signals thereto. By this analog-to-video converting circuit **65**, the output signals of the D/A converting circuits **61** through **63** are converted to a video signal and sent subsequently.

In addition, the output data of the de-interleave and the error correction circuit **52** are also supplied to a transparency control table **66** (this table being referred to hereinafter as the TCT). The TCT **66** is configured to detect a "load TCT" instruction in the output data of the de-interleave and error correction circuit **52** in accordance with the kind of the modes and instruction indicated by the output signal of the mode/instruction decoder **53**, hold transparency control bits TCB-0 through TCB-15, and output by selecting one of the TCB-0 through TCB-15 being held, corresponding to a

color number indicated by the data read-out from the picture memory device 55.

The output signal of the TCT 66 is supplied to a video switch 33 as a control signal. In addition to the output signal of the TCT 66, the video format signal obtained from the subcode and outputted by the analog-to-video converting circuit 65, and the video format signal outputted by the video format signal demodulating and processing circuit 30 are supplied to the video switch 33.

In the video switch 33, the video format signal obtained from the subcode is supplied to a stationary contact x of the changeover switch 68, and also supplied to its stationary contact y through a resistor R_1. No connection is made to a stationary contact z of the changeover switch 68. The changeover switch 68 is configured to selectively output one of the signals supplied to its stationary contacts x, Y, z by moving its movable contact u to be in contact with one of the stationary contacts x, y, z in accordance with a control signal issued from the TCT 66. The video format signal outputted from the video format signal demodulating and processing circuit 30 is directly supplied to a stationary contact z of a changeover switch 69 and also supplied to its stationary contact y through a resistor R_2. No connection is made to a stationary contact x of the changeover switch 69. The changeover switch 69, like the changeover switch 68, is configured to move its movable contact u to be in contact with one of its stationary contacts x, y, z in accordance with the control signal. The movable contacts u, u of the changeover switches 68 and 69 are mutually connected. A resistor R_3 is connected between a common junction J of the movable contacts u, u and ground. A mixed signal of the video format signal obtained from the subcode and the video format signal outputted from the video format signal demodulating and processing circuit 30 is derived at the common junction J. When the movable contacts u, u of the changeover switches 68 and 69 are in contact with the stationary contacts X, x respectively, the mixing ratio of the video format signal obtained from the subcode becomes 100%, and the mixing ratio is reduced to 0% when the movable contacts u, u are in contact with the stationary contacts z, z. When, on the other hand, the movable contacts Z. z are in contact with the stationary contacts y, y, the mixing ratio is equal to M which is determined by the resistors R_1 and R_2, and the resistance of the resistors R_1 and R_2 are selected so that M has a value between 20% and 80%. The signal derived at the common junction J is supplied to a video output terminal OUT_3.

A position detector 70 is provided in the vicinity of the path of the movement of pickup 22 along the radial direction of disc, and serves to detect when the beam spot emitted from the pickup 22 has reached a position corresponding to the vicinity of the boundary between the CD are and the video area of a composite disc, to produce a detection signal. By the generation of this detection signal, a state that the pickup 22 has reached to the video area can be detected. The position detector 70 can have a known structure including for example an optical sensor. The detection signal outputted by the position detector 70 is supplied to the system controller 32.

The system controller 32 comprises a microcomputer which consists of a processor, a ROM (read only memory), a RAM and so on. The system controller 32 is supplied with various signals and information such as the horizontal sync signal h, the vertical sync signal v, and the control data c, the P-channel and Q-channel bits in the subcode outputted from the EFM demodulation circuit 42, disc designation information from a control part 60 indicating whether the disc to be played is a compact disc or a composite disc, and mode designation information from the control part 60, indicating whether the reproducing area is only the CD area or the video area, or both CD and video areas in the case of the playback of a composite disc. In this system controller 32, the processor executes processing of the signals inputted in accordance with programs previously stored in the ROM, and performs the control operation of each part of the video format signal demodulating and processing circuit 30, the selector switch 35, a drive circuit (not shown) for driving the spindle motor 21, the driving circuit 71 for driving the slider motor, and the display part 72.

FIG. 13 is a block diagram showing a specific circuit construction of the video format signal demodulating and processing circuit 30. As shown, the RF signal from the RF amplifier 26 is demodulated at a demodulation circuit 75, then supplied to a time base correction circuit 76 and to a separator circuit 77. In the separator circuit 77, the horizontal sync signal h, the vertical sync signal v and the control data c which are contained in the video format signal are extracted. The time base correction circuit 76 consists of, for example, a variable delay element of e.g. CCD (charge coupled device) and configured to vary the delay amount of that element in accordance with a control signal from a time base control circuit 78. The time base control circuit 78 is configured to output as the control signal a signal corresponding to a phase difference between an oscillation signal and its divided signal of a crystal oscillator (VCO) 79 which oscillates, for example, in synchronism with the horizontal sync signal h extracted at the separator circuit 77, and the horizontal sync signal and the color burst signal of the video signal transmitted through the time base correction circuit 76. For more specific configuration, reference is directed for example Japanese patent application laid-open number P56-102182.

The video signal having been processed by the time base correction operation is used as one input of a selector switch 80, and also supplied to an A/D converter 82 through an LPF (Low Pass Filter) 81. In the A/D converter 82, the sampling of the video signal is performed at intervals of a predetermined period, and the thus obtained sampled values are in turn converted to digital data. The output data of the A/D converter 82 is supplied to a video memory 83 consisting of a RAM (random access memory) and so on. A memory having a capacity for storing video information of at least one field long is used as the video memory 83. Address and mode controls of this video memory 83 are performed by a memory control circuit 84. The memory control circuit 84 is configured to perform control operations for sequentially read-out data written in each address of the video memory 83 in accordance with a clock from a reference clock generating circuit 85, and for rewriting the contents of each address of the video memory 83 in response to a write enable signal w which is outputted from the system controller 32. The data read-out from the video memory 83 is converted to an analog signal in a D/A (digital to analog) converter 86, and supplied through an LPF 87 as the other input to the selector switch 80. The selector switch 80 is normally

held at a position a to selectively output the video format signal directly supplied from the time base correction circuit 76, and switched to a position b in response to a changeover command from the system controller 32, to selectively output the video format signal having been processed through the video memory 83.

Operations of the processor in the system controller 32 in the above configuration will be specifically explained with reference to the flowchart of FIG. 15.

Assume that a composite disc is set in a playback position. When a start command is issued in this state, the processor transmits a drive command to the motor driving circuit 71, so that the slider motor 24 is driven to move the pickup 22 to an innermost peripheral position (step S1). If it is detected that the pickup 22 has reached the innermost peripheral position by means of a detector switch of any usual configuration (not shown), the processor executes a focusing operation of the pickup 22, and performs the read-in of index code information which is recorded in an audio lead-in area at an innermost peripheral area of the disc (step S2). Subsequently, the processor judges whether or not the disc being set is a composite disc or not, on the basis of the value of predetermined bits of the control signal portion for example, of the data block which is constituted by the Q-channel bits constituting the subcode in the read information (step S3). If it is judged that the disc being set is a compact disc, then the execution directly proceeds to a CD playback mode (step S4) and a playback operation is continuously performed unless any command for the programmed music selecting operation for example has been issued. Since the playback operation in the CD playback mode itself is well known, the explanation thereof is omitted here.

If it is judged in the step S3 that the disc being set is a composite disc, The processor judges whether or not the subcode graphics data is recorded (step S5), by using the code constituted by bits in the control field among the R-channel bits constituting the subcode in the read-out information obtained by the step S2. If it is judged in the step S5 that the subcode graphics data is recorded, the processor detects and displays at a character display, for example, as the display part 72 the channel number of the recorded picture channels and the group of characters composing a note which provides an explanation of contents (step S6), by using the codes constituted by bits in the data field among the R-channel bits which constitute the subcode in the read-out information obtained by the step S2. In this step, if character display is not used as the display part 72, it is also possible to arrange such that only the channel number of the recorded picture channels is displayed. In such a case, it is preferable to provide, for example, 16 LEDs respectively corresponding to the 16 picture channels in the display part 72, and to light-up only a part of LEDs corresponding to the recorded picture channels among the 16 LEDS.

After this step, the processor immediately accelerates the slider motor 21 to a maximum rated speed of rotation for the video area (step S7). At the same time, the processor moves the pickup 22 toward the outer periphery of disc at a high speed by driving the slider motor 24 at a high speed (step S8).

If it is judged, in the step S5, that the subcode graphics data is not recorded, the processor immediately proceeds to the step S7.

After these operations, when it is detected that the pickup 22 has reached to the video area by the detection signal from the position detector 70 (step S9), the processor starts the playback operation of the video area (step S10). During video area playback, the processor performs the control operation for writing the video information of at least one field (or one frame) long obtained from the disc in the video memory 83. This video information to be written may be, for example, first information in the video area, or designated by an address designation through the key operation of the operation part 60. Along with these operations, the processor judges whether or not the picture channel designation code is in the control data c outputted by the separator circuit 77 (step S11). If it is judged that there is the picture channel designation code, the processor supplies the corresponding data d to the memory control circuit 57 (step S12), and then judges as to whether or not the playback of video area has completed (step S13).

If it is judged, in the step S11, that the picture channel designation code is not in the control data c, the processor judges as to whether or not the designation of picture channel is performed by the key operation in the control part 60 (step S14). If it is judged that the designation of picture channel is performed, the processor supplies data d corresponding to the designated picture channel to the memory control circuit 57 (step S15), then proceeds to the step S13.

If it is judged, in the step S14, that the designation of picture channel by the key operation is not performed, the processor supplies data d corresponding to a predetermined picture channel to the memory control circuit 57 (step S16), then proceeds to the step S13.

If it is judged, in the step S13, that the playback of video area has not been completed, the processor again proceeds to the step S11.

If it is detected in the step S13, that the playback of the video area has been completed, then the processor decelerates the spindle motor 21 to the maximum rated speed of rotation for the CD area (step S17). At the same time, the processor drives the slider motor 24 at a high speed, to move the pickup 22 to the innermost peripheral position of the disc at a high speed (step S18). If it is detected (step S19) that the pickup 22 has reached the innermost peripheral position by the detection output signal of the above mentioned detector switch (not illustrated), the processor starts playback operation of the CD area (step S20). Concurrently to this, the selector switch 80 in the video format signal demodulating and processing circuit 30 is changed over by the processor to the position b thereby selecting and outputting the video information which was written in the video memory 83 during video area playback. Thus, playback of a still picture is performed during CD area playback.

During the playback of CD area, the processor judges whether or not the designation of picture channel is performed by the key operation in the operation part 60 (step S21). If it is judged that the designation of picture channel is performed by the key operation, the processor supplies data d corresponding to the designated picture channel to the memory control circuit 57 (step S22), and judges whether or not the playback of CD area has been completed by the read-out of information in the audio lead-out area (step S24).

If it is judged, in the step S21, that the designation of picture channel by the key operation is not performed, the processor supplies data d corresponding to the predetermined picture channel to the control part 57 (step S23), and proceeds to the step S24.

In the step S24, if it is judged that the playback of CD area has not been completed, the processor again proceeds to the step S21. When, on the other hand, the completion of the CD area playback is judged, the processor initiate the driving of the slider motor 24 to move the pickup 22 to its home position (step 25). Furthermore, a loading mechanism (not shown in the drawings) performs disc ejection, to complete the playback operating sequence.

In the operating sequence described above, playback of the information recorded in the CD area of the composite disc is performed in steps S17 through S24 after the playback of information recorded in the video area in steps S1 through S16. In these operations, the channel number and the group of characters indicating the contents of the picture channels, in which picture is recorded as the subcode, are displayed in the display part 72 immediately before the start of the playback of video area by the steps S5 and S6.

Therefore, it is possible to know before the start of the playback of the video area or the CD area the channel number and the contents of the pictures by the subcode which can be superimposed on the picture by the video format signal recorded in the video area. In addition, the picture channel can be selected by the key operation of the operation part 60 through the steps S14 and S15 executed during playback of the video area, or through the steps S21 and S22 executed during the playback of the CD area. Thus, desired picture can be easily selected.

When the "load CLUT color 0 through color 7" instructions and the "load CLUT color 8 through color 15" instructions are decoded by the mode/instruction decoder 53 during video area playback, data of designated 16 colors among 4096 colors are held in the CLUT 58.

Subsequently, by the decoding of the "write font foreground/background" instruction etc., picture data of 16 channels are in turn stored in the RAM 56*a* through 56*p* in the picture memory device 55. In this state when one of the picture data of 16 channels is designated by data corresponding to the key operation in the operation part 60, picture data of the designated channel is sequentially outputted from the picture memory device 55, and in turn supplied to the CLUT 58. By this operation, color data of a color number indicated by the picture data is then outputted from the CLUT 58. A video format signal based on this color data is outputted from the analog video converting circuit 65, and supplied to the video switch 33.

If the "load TCT" instruction is decoded in this state, the transparency control bits TCB-0 through TCB-15 respectively corresponding to each color number are then held in the TCT 66. Among the TCB-0 through TCB-15 being held, one corresponding to the color number indicated by the data read-out from the picture memory device 55 is selectively outputted from the TCT 66, and the mixing ratio in the video switch 33 is designated by the output of the TCT 66. Thus, the mixing ratio between the video format signal outputted from the analog-to-video converting circuit 65 and the video format signal outputted from the video format signal demodulating and processing circuit 30 is controlled for each pixel. Consequently, a combination of pictures such as illustrated in FIG. 16 is made possible. Specifically, the mixing ratio is set to 100% for a portion corresponding to each pixel outside a region D of a picture A based on the video format signal outputted from the video format signal demodulating and processing circuit 30, and set to 0% for a portion corresponding to each pixel within the region D. On the other hand, the mixing ratio is set to 0% for a portion corresponding to each pixel outside a region D' of a picture B based on the video format signal outputted from the analog-to-video converting circuit 65, and set to 100% for a portion corresponding to each pixel within the region D' of the picture B. Then a picture C can be formed by combining the portion of the picture A outside the region D and and the portion of the picture B within the region D'.

In this way, it is possible to compose a picture as illustrated in FIGS. 17A through 17C, in which a translation of a dialogue, a musical score, or an explanation of a scene, etc., obtained from the subcode is inserted into a moving picture obtained by the video format signal recorded in the video area.

By sequentially processing the signal read-out from the disc 20 in this way, pictures by the subcode which are related to the motion picture obtained by the video format signal can be superimposed on the motion picture by the video format signal which are recorded by the FM modulation. Thus, a reproduced picture with variety and causing no sense of incompatibility can be easily obtained.

Furthermore, when the picture obtained by the subcode is inserted in the still picture obtained by using the video memory 83, the read-out of the information recorded on the disc 20 is performed continuously. Therefore, the picture obtained by the subcode is played with the sound in the order of recording, and there will be no problem of generating the sense of incompatibility.

Moreover, by inserting data corresponding to characters of a plurality of languages in each of the picture channel, it becomes possible to record captions (translations of dialogues) in a plurality of languages in a single disc, and to selectively display the caption (translation of dialogues) in a desired language in accordance with a key operation in the operation part 60. Thus, the preparation of a plurality of mother discs for different languages is no more required.

FIG. 17 is a diagram showing another embodiment of the present invention. In this embodiment, codes to be inserted as the symbol 0 are set for designating "extended ling-graphics mode" and "extended TV-graphics mode" in addition to the four modes of "zero mode", "line-graphics mode", "TV-graphics mode", and "user's mode" in the conventional system.

The composition of picture in the "extended line-graphics mode" is the same as in the "line-graphics mode", and an instruction designated by a "set TCW" (set Transparent Control Word) having a structure shown in FIG. 19, and an instruction designated as "write font" shown in FIG. 20 are provided. The "set TCW" instruction is such an instruction in which each of the bits b_0 through b_7 of TCW represented by 8 bits of the channels T through W of the symbols 4 and 5 corresponds to each of the color numbers indicative of the eight colors in the "line-graphics mode", and which sets the mixing ratio to either one of 0% and 100% for each of the groups of pixels to which the corresponding color number is designated respectively, by using the value of the bits b_0 through b_7. On the other hand, the "write font" instruction, like the "write font" instruction in the "line-graphics mode", is an instruction for writing the font data in the designated locations in the picture memory, and at the same time, setting the mix-

ing ratio to either one of 0% and 100% for each of groups of the pixels to which two color numbers represented respectively by 3 bits of the channels U through W of the symbols 4 and 5 are designated, by means of the value of each of the bits T_0, T_1 of the channel T of the symbols 4 and 5.

The composition of picture in the "extended TV-graphics mode" is the same as in the "TV-graphics mode", and this mode is provided with the instruction designated as "set TCW" illustrated in FIG. 21, and an instruction designated as "pre-set memory" illustrated in FIG. 22. The "set TCW" instruction in the "extended TV-graphics mode" is such an instruction in which bits b_0 through b_{15} of the TCW represented by 16 bits of the channels T through W of the symbols 4 through 7 respectively correspond to the color numbers indicating the 16 colors in the "TV-graphics mode", and which sets the mixing ratio to either one of 0% and 100% for each of groups of pixels to which corresponding color number is designated, by using the value of each of the bits b_0 through b_{15}. The "pre-set instruction" instruction, on the other hand, is an instruction for setting the mixing ratio to either one of 0% and 100% for each of groups of pixels to which colors of the color numbers represented by the four bits of the channels T through W of the symbol 4 are designated respectively, by using the value of the bit T of the channel R of the symbol 4.

The picture information recorded as the subcode using the recording format explained so far can be processed by making the configuration of the TCT 66 in the apparatus shown in FIGS. 13A through 13C such that data representing the mixing ratio is held correspondingly to each color number by means of the "set TCW" instruction, the "write font" instruction, and the "pre-set memory" instruction.

In the embodiment described above, the number of bits of the instruction codes indicating the mixing ratio in each position of two-dimensional picture formed by the video format signal, is described as 1 or 2. However, the number of bits of this instruction codes can be set to be any value as long as the number does not exceeds the bit number of the data field in one pack.

In the above, the present invention has been described by way of example in which graphic codes including picture information and instruction codes indicating the mixing ratio at each position of the two-dimensional picture formed by the video format signal are recorded on a recording medium by inserting those codes as the subcode of the coded information signal. Now, explanation will be made for a case in which the graphic code including the picture information and instruction codes for designating areas in the two-dimensional picture formed by the video format signal are recorded on a recording medium, by inserting those codes as the subcode of the coded information signal.

At first, as in the system illustrated in FIG. 18, codes to be inserted as the symbol 0 for designating "extended ling-graphics mode" and "extended TV-graphics mode" in addition to the four modes of "zero mode", "line-graphics mode", "TV-graphics mode", and "user's mode" in the conventional system, are set.

The composition of picture in the "extended line-graphics mode" is the same as in the "line-graphics mode", and an instruction designated by a "set window" having a structure shown in FIG. 23 is provided. The "set window" instruction in the "line-graphics mode" is an instruction for determining an area of rectangular form designated as "window" in a position on the picture designated by four bits of the channels T through W of the symbol 4. Since the "screen area" has only two rows of "fonts" in the "line-graphics mode", the whole area of the "screen area" is designated as the "window", and only the position of the "window" in the vertical direction on the screen of CRT display is determined, as illustrated by the oblique lines in FIG. 23. In addition, the mixing ratio is designated by two bits of the channels R and S of the symbol 4.

The composition of picture in the "extended TV-graphics mode" is the same as in the "TV-graphics mode", and there are an instruction designated as "set-window" illustrated in FIG. 25, an instruction illustrated in FIG. 26 which is a modification of the "pre-set memory" instruction in the "TV-graphics mode", and an instruction illustrated in FIG. 27 which is a modification of an instruction designated as "pre-set border".

The "set window" instruction in the "extended TV-graphics mode" is an instruction in which an area of rectangular form designated as "window" is determined by the positions in the picture which are in turn defined by the symbols 6 and 7, and the symbols 8 and 9. The position of a point (s_x, s_y) corresponding to the left-top corner of the "window" in the vertical direction is indicated, in "row" number, by five bits of the channels S through W of the symbol 6, and the position of the point (s_x, s_y) in the horizontal direction is indicated, in "column" number, by six bits of the channels R through W of the symbol 7. On the other hand, the position of a point (e_x, e_y) corresponding to the right-bottom corner of the "window" in the vertical direction is indicated, in "row" number, by five bits of the channels S through W of the symbol 8, and the position of the point (e_x, e_y) in the horizontal direction is indicated, in "column" number, by six bits of the channels R through W of the symbol 9. By this "set window" instruction, an window such as illustrated by the oblique lines in FIG. 28 is determined in picture on the display screen.

In the area of "window" set by the above procedure, display is performed by using a signal obtained by mixing the video format signal obtained on the basis of the subcode, and a video format signal which is recorded with the digital signal including the subcode by a multiplex recording after being processed by an FM-modulation, for example. The mixing ratio between these video format signals is designated to be one of 0%, 30%, 70%, and 100% by using two bits of the channels R and S of the symbol 4.

The "pre-set memory" instruction in the "extended line-graphics mode" is, like the corresponding instruction in the "line-graphics mode", an instruction by which the color of all "fonts" in the memory is determined to be one color in 16 colors of the color numbers "0" through "16" which is designated by four bits of the channels T through W constituting the symbol 4, and the mixing ratio is determined to be a value designated by two bits of the channels R and S constituting the symbol 4.

The "pre-set border" instruction in the "extended TV-graphics mode" is, like the corresponding instruction in the "TV-graphics mode", an instruction by which the color of all "fonts" of the "border" portion in the memory is determined to be one color in 16 colors of the color numbers "0" through "16" which is designated by four bits of the channels T through W constituting the symbol 4, and the mixing ratio is determined to be a value designated by two bits of the channels R and S constituting the symbol 4.

FIGS. 29A through 29C show a disc player for playing a composite disc as illustrated in FIG. 10 carrying a digital audio signal as the coded information signal into which the subcode including the picture information is inserted in the manner explained above. In these figures, the disc player is constructed generally the same as the disc player shown in FIGS. 13A through 13C, and the mutual connection is the same for various parts, i.e., the spindle motor 21 for driving the disc 20, pickup 22, slider 23, slider motor 24, transmission mechanism 25, RF amplifier 26, video format signal demodulating and processing circuit 30, coded information signal demodulating and processing circuit 31', system controller 32, video switch 33, operation part 60, position detector 70, motor driving circuit 71, and display part 72.

In the disc player system of this example, however, the coded information signal demodulating and processing circuit 31' does not include the TCT 66 which is used in the disc player shown in FIGS. 13A through 13C, and the output data of the de-interleave and error correction circuit 52 is also supplied to a window property memory device 90. The window property memory device 90 is made up of a RAM 91 having memory addresses corresponding to all "fonts" on the picture having 50 "fonts" in the row direction and 18 "fonts" in the column direction, and capable of storing 2 bits of data in each memory address, and a memory control circuit 92. The memory control circuit 92 is configured to perform control operations of: detecting the data indicating the position of window and the data indicating the mixing ratio, out of the data outputted from the de-interleave and error correction circuit 52, in accordance with the mode and the sort of the instruction indicated by the output of the mode/instruction decoder 53; writing data indicating the detected mixing ratio in the memory addresses of the RAM 91 corresponding to the "fonts" in the window; writing data corresponding to the mixing ratio of 0% of the video format signal obtained from the subcode in the memory address corresponding to the "fonts" outside the window, and sequentially reading-out the recorded contents of the RAM 91 in a predetermined order in accordance with the horizontal and vertical synchronizing signals h, and v. Output data of this window property memory 90 device is supplied to a switch control circuit 93. The switch control circuit 93 is configured to supply a control signal corresponding to the mixing ratio of each "font", which is indicated by the output data of the window property memory device 90, to the video switch 33.

On the other hand, in the video switch 33, the video format signal obtained from the subcode is directly supplied to a stationary contact v of a changeover switch 95, and also to stationary contacts x and y thereof through resistors R_4 and R_5. No connection is made to the stationary contact z of the changeover switch 95. The changeover switch 95 is configured to selectively output one of the signals at the stationary contacts u, x, y, and z by moving a movable contact t thereof to contact with one of the stationary contacts u, x, y, and z in accordance with the control signal outputted by the switch control circuit 93. On the other hand, the video format signal from the video format signal demodulating and processing circuit 30 is directly supplied to a stationary contact z of a changeover switch 96, and also supplied to stationary contacts y and x thereof through resistors R_6 and R_7. No connection is made to a stationary contact z of the changeover switch 96. The changeover switch 96 is, like the changeover switch 95, constructed to connect a movable contact t to one of the stationary contacts u, x, y, and z in accordance with the control signal. The movable contacts t, t of the changeover switches 95 and 96 are mutually connected with each other. A signal of mixture between the video format signal obtained from the subcode and the video format signal from the video format signal demodulating and processing circuit 30 is derived at the common connection node J of the movable contacts t, t. When the movable contacts t, t of the changeover switches 95 and 96 are connected to the stationary contacts u, u, the mixing ratio of the video format signal obtained by the subcode becomes equal to 100%, and this mixing ratio becomes equal to 0% when the movable contacts t, t of the changeover switch 95 and 96 are connected to the stationary contacts z, z. On the other hand, the resistance value of the resistors R_4 through R_7 are determined so that the mixing ratio becomes equal to 70% when the movable contacts t, t are connected to the stationary contacts x, x, and it becomes equal to 30% when the stationary contacts t, t are connected to the movable contacts y, y. The signal derived at the common connection node J is supplied to the video output terminal OUT_3.

With the above described arrangement, the color data of the designated 16 colors out of the 4096 colors are also held in the CLUT 58 when the "load CLUT color 0 through color 7" instruction and "load CLUT color 8 through color 15" instruction are decoded by the mode/instruction decoder 53.

Subsequently, picture data of 16 channels are stored in the RAMs 56*a* through 56*p* of the picture memory device 55 by the decode of the "write font foreground-/background" instruction. When one of the color data of 16 channels is designated by a data d based on the key operation in the operation part 60, picture data of the designated channel is sequentially outputted from the picture memory device 55 and in turn supplied to the CLUT 58. Consequently, the color data of the color number indicated by the picture data is outputted from the CLUT 58. Then a video signal based on this color data is outputted from the analog-to-video converting circuit 65 and in turn supplied to the video switch 33.

In this state, if the "window set" instruction is decoded, data indicating the mixing ratio of 10% for the video format signal obtained from the subcode is stored in the memory addresses of the RAM 91 of the window property memory device 90 corresponding to the "fonts" outside the window designated by the "window set" instruction. Data indicating the mixing ratio designated by the "window set" instruction is written in the memory addresses corresponding to the "fonts" within the window. The data read-out from the RAM 90 of the window property memory device 91 is supplied to the video switch 33, so that the mixing ratio between the video format signal outputted from the analog-to-video converting circuit 65 and the video format signal outputted from the video format signal processing circuit 30 is controlled for each "font". Thus, the same function as that in the disc player shown in FIGS. 13A through 13C is attained.

In addition, in the embodiment described above, the recording medium on which the subcode carrying picture information is recorded is a composite disc generally designated a CDV. However, it is of course possible to use, as the recording medium on which the subcode carrying the picture information is to be recorded,

other type of recording medium such as a disc designated as LDD, i.e., a disc on which an FM-modulated video format signal, an audio signal, and a digital audio signal are record by multiplexing, by using a frequency multiplexing system, and so on.

In the description of the disc players of FIGS. 13A through 13C, and 29A through 29C, the R-channel bits including the identification code information of picture channels are supplied to the system controller 32, and the identification code information is displayed by the displayed part 72. However, it is also possible to generate a video format signal corresponding to the identification code information by separately providing a decoder for decoding the identification code information, and to superimpose the identification code information on the picture by the video format signal recorded in the video area, by mixing the generated video format signal with the signal derived at the junction j of the video switch 33.

It will be appreciated from the foregoing description, the recording and reproducing method according to the present invention is characterized by the steps of recording, in addition to a video format signal and a coded information signal, graphic codes including picture information occupying at least one of N (N being a natural number equal to or greater than 2) channels, in a first recording area of a recording medium by inserting the graphic codes as the subcode of the coded information signal, recording identification code information of at least one channel in a second area of the recording medium, displaying, at a time of playing of the recording medium, the identification code information, and mixing to the video format signal a picture signal corresponding to said graphic codes occupying a channel designated by a picture channel command for designating one channel in the channel group. Therefore, one of a plurality of pictures obtained by the subcode which are related to the picture by the video format signal can be selected without fail and in turn used for the superimposition by only sequentially processing the signal obtained from the recording medium. Thus, a reproduction picture having variety and causing no sense of incompatibility, as well as being in accord with user's demand, can be easily obtained according to the present invention.

What is claimed is:

1. A method of recording and reproducing picture information on a recording medium having a lead-in area and a program area to be played after the lead-in area, the method comprising the steps of:

inserting a plurality of graphic subcodes including picture information in a coded information signal, wherein said graphic subcodes occupy at least one signal source channel in a signal source channel group of N channels where N is a natural number greater than 1;

recording said information signal including said graphic subcodes occupying at least one signal source channel in said program area of said recording medium;

recording in said lead-in area identification code information representing a content of said graphic subcodes occupying said at least one signal source channel in said program area of said recording medium;

displaying said identification code information when said recording medium is to be played; and

mixing with a video format signal a picture signal corresponding to graphic subcodes occupying one signal source channel in said signal source channel group of N channels designated by a picture channel command.

2. A method as claimed in claim 1, further comprising the steps of:

recording content identification information in said lead-in area of the recording medium, wherein said content identification information is indicative of contents of the picture information occupying said at least one channel; and

displaying said content identification information when said recording medium is to be played.

3. A method as claimed in claim 1, wherein said picture channel command is issued by a manual operation.

4. A method as claimed in claim 1, wherein said video format signal is recorded with said coded information signal in said program area of said recording medium.

5. A method as claimed in claim 4 further comprising a step of inserting said picture channel command into said video format signal.

6. An apparatus for playing a picture information recording medium having a program area on which are recorded graphic subcodes in a coded information signal, wherein said graphic subcodes include picture information occupying at least one signal source channel in a signal source channel group of N channels wherein N is a natural number greater than 1, said medium having a lead-in area on which identification code information of said at least one signal source channel of said graphic subcodes recorded in said program area is recorded, said apparatus comprising:

pickup means for reading signals recorded on said lead-in and program areas of said recording medium and generating a pickup output signal;

coded information signal demodulating means for demodulating said coded information signal from said pickup output signal;

graphic subcodes demodulating means for demodulating said graphic subcodes from an output signal of the coded information demodulating means;

generating means for generating a picture signal corresponding to said graphic subcodes from an output signal of said graphic subcodes demodulating means;

display means for displaying said identification code information; and

mixing means for mixing with a video format signal said picture signal corresponding to the graphic subcodes occupying a signal source channel designated by a picture channel command for designating one signal source channel in said signal source channel group.

7. An apparatus as claimed in claim 6, wherein contents identification information indicating contents of said picture information occupying at least one channel is recorded in said lead-in area of said recording medium, and wherein said apparatus further comprises means for displaying said contents identification information.

8. An apparatus as claimed in claim 6, further comprising a manually operable input means for inputting said picture channel command.

9. An apparatus as claimed in claim 6, wherein said video format signal is recorded in said program area of said picture information recording medium and wherein the apparatus further comprises video format signal demodulating means for demodulating said video format signal from said pickup output signal.

10. An apparatus as claimed in claim 9, wherein said picture channel command is a command which has been inserted in said video format signal.

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